Chapter 9

Transaction log analysis for exploring search patterns of the OPAC users of University of Moratuwa

C. N. D. Punchihewa and A. D. B. Kumara

Abstract

This transaction log analysis study aimed to identify the searching behaviour, searching patterns and causes of search failures of the patrons with the Online Public Access Catalogue (OPAC) of the University of Moratuwa. Further, this study could guide implementing various changes to improve the Library Management System (LMS) and its OPAC, re-structure the library's user education programmes, and identify the necessary adjustments required for different types of library services. The OPAC transaction log contained 95,340 records for three months (from August to October 2019) and was analysed statistically using multivariate techniques. Two kinds of transaction logs were identified in this study. It was considered 68,618 records as non-logged transactions and 9,592 records as logged transactions. According to the results of the study, the average number of transactions per month was 26,070. The average number of non-logged transactions per month was 22,873, and the average logged transactions per month was 3,197. Results of the study have evidenced that the patrons highly preferred the simple search interface over the advanced search interface. The keyword search was the most popular searching option of the patrons in simple search, and many filtering options offered in the advanced search interface were underutilised. The study results have forced the library to redesign its user education programmes to provide better awareness, knowledge, and skills for patrons in handling OPAC. The library should regularly emphasise OPAC's features and advantages among the students using various promotional activities such as user awareness workshops, leaflets, discussion forums or chat services, etc. The functionality and design of the OPAC should be reformed to satisfy the patrons and their information needs.

Keywords: Query formulation, Transaction log analysis, Search Patterns

Introduction

As a service organisation, the main scope of any library is to provide quality service continuously to its patrons. Expectations and needs of modern library patrons have significantly changed with the speedy and continuous development of technology. Therefore, the role of the librarians and the libraries have completely altered (Onuoha & Obialor, 2015; Wenborn, 2018). The evolution of technology has tremendously transformed the traditional library techniques in information dissemination and storing. Different kinds of new approaches have been implemented for library operations and services such as cataloguing and classification, acquisition, processing storage, retrieval, and dissemination of information to suit the needs of modern library users. OPAC, online renewal, reservation and inquiry facilities, self checking-checkout systems are some of the new services offered through the Library Management System (LMS). Further, the introduction of regularly updated library websites, digital libraries, online helpdesk, email and SMS alert services, promotional activities with social media has helped provide solutions for the new challenges in providing a continuous service through the latest technologies.

Libraries should have a clear view of patrons' needs and their problems in satisfying the user requirements. Therefore, libraries conduct different user studies to identify user needs and related problems. The main aspects of these user studies are discovering the patrons' perspectives, exploring their behaviours, measuring patron satisfaction, and fulfilling their needs are the main aspects of these user studies. Measuring the usage of OPAC indicates how well the patrons have used the library system. These studies allow the librarians to decide how the LMS and facilities of OPAC can be improved to suit the user needs. Further, this helps to evaluate the success of library user education programmes, particularly in information searching. Moreover, study results could be used to improve and redesign library services.

Surveys, focus group studies and transaction log analysis are different techniques applied by the libraries to measure electronic resources usage (Arshad & Ameen, 2015). As the authors have indicated, transaction log analysis of OPAC is one of the best approaches to monitor the usage of online catalogues and the behaviour of the users in information searching using OPAC.

Search activities of users in a website or LMS are stored in a special kind of file called a 'log file' containing specific information such as accessed date, time, IP address, etc. Bauer (2000) has indicated (in Arshad & Ameen, 2015) a log file as a

record of transactions that contains requests from a user's browser and sent to the host server. A transaction contains a request made by the user, followed by a reply from the system. According to Jansen (2006), the transaction log is a file that includes the communication information between a system and the system users. This log file could be analysed manually or with statistical software packages, and the entire procedure is called 'Log Analysis'.

Transaction log analysis is a tool which applies to study online systems since the 1960s. In the early stages, transaction log analyses were used only to monitor the system performance. Later, it was utilised to measure the different aspects such as user behaviour and user interaction with the systems (Holloman, 1999). The transaction log analysis is applied in various ways to explore the information-seeking behaviour of library patrons. Analysis of failure rates is one popular technique used in OPAC transaction log analysis to observe the user behaviour patterns. The results allow the library to explore the possible reasons for patrons' failures when searching information with OPAC. Also, transaction log analysis could be applied as a management tool. Results of the analysis help to make the system changes, determine the resource allocation, alter the user interface, and make the decisions on collection development. Results of transaction log analysis could be used to improve the concepts and the techniques of library user education programmes.

There are many advantages of selecting the transaction log analysis method to identify the user interaction with the information systems. Transaction log analysis is a popular technique used to collect the usage of library systems without direct user involvement at the data-gathering stage (Arshad & Ameen, 2015). Also, it provides the opportunity to observe the user interaction with the system without researchers' extra efforts, such as distributing questionnaires or conducting interviews. As Malliari and Kyriaki-Manessi (2007) explained, transaction log analysis provides information about the users' behaviour with the OPAC without the user being influenced by the researcher's presence. An unbiased research data collection is guaranteed with this process. The transaction log analysis study is a relatively low-cost method as it does not require any staff to collect data, and no incentives are needed to offer the participants. In-house transaction logs reduce the time needed for organising the data for analysis. A large amount of data with a wide range of users could be obtained within a given period from transaction log analysis. Obtaining the same amount of data using other research methods would be very expensive and time-consuming (Brett et al., 2015).

Background of the study

According to Hienert (2017), log analysis is used to analyse the interaction between the user and the system of searching. Blecic et al. (1998, p. 40) described the transaction log analysis as "the detailed and systematic examination of each search command or query by a user and the following database result or output by the OPAC".

Peters (1993) has divided the development of transaction log studies in libraries into three stages. In the first stage, from 1960 to late 1970, monitoring the system performance was the primary purpose of the conducting transaction log analysis process. When online catalogues were introduced to the libraries with LMS in the early 1980s, OPAC transaction log analysis was used to measure different aspects of the libraries, such as patrons' behavioural activities and patron interactions with OPAC. This could be considered as the second stage of the development of transaction log analysis studies. Diversification could be observed as the main feature during the mid-1980s, which could be considered the third stage of transaction log analysis. Some researchers have selected transaction log analysis to evaluate specific search states or specific user groups.

Most libraries worldwide have used transaction log analysis studies as a primary instrumental tool to identify the patrons' interaction with their library systems and suggest the necessary modifications required for the library system. As Jansen (2006) mentioned, researchers have applied transaction log analysis studies to evaluate various information systems such as library management systems, conventional Information Retrieval (IR) systems and web systems.

A study was carried out by Arshad and Ameen (2015) to measure the usage patterns of the Punjab University library website. The results revealed that in-house campus users had shown the highest accessed percentage of the library website. Some of their highly used resources were free scholarly journals, e-books and e-journals. In another study, Brett et al. (2015) focused on analysing the search activities of patrons using a tabbed search interface on the home page of the University of Houston Library web page. In this study, transaction log analysis was applied to collect the information on search terms, accessed date, accessed time, and the search location (either within the university or outside the university).

The purpose of the study conducted by Han et al. (2014) was to identify the users' query constructing behaviour and compare query patterns of external and internal

users of the image-based digital library at the University of Wisconsin-Milwaukee using transaction log analysis. The researchers identified the most frequently used queries, the frequency of the used terms and the relationship of query terms. Jones et al. (2000) carried out similar research to analyse the user activity in Digital Library at the University of Waikato, New Zealand, using the transaction log analysis. The researchers mainly focused on how patrons use Boolean operators and search options in constructing the queries. Further, they explored the patterns of patrons in query building and modification. In these studies, researchers identified the general mistakes of the patrons in information searching and observed the distribution of query terms presented in the logs.

Hunter (1991) conducted a transaction log study to gather data on failure rates, usage patterns and causes of problems at North Carolina State University. According to his research, 54% of the searches analysed have failed. Searches that retrieved item-level results were considered success hits, and the searches that never retrieved an item level result were considered zero (failed) hits. Hunter has made a strong statement regarding this alternate definition of zero (failed) hits in his study. He has mentioned that all the zero hits do not always represent the failures of the patrons. They may have performed the search correctly, but patrons may receive zero hits due to the unavailability of the searched item in the database.

Hettiarachchi et al. (2017) conducted a study to explore the frequently used search fields and searching behaviour of undergraduate students at the University of Ruhuna after analysing the OPAC transaction logs created from 2012 to 2016. The findings revealed that keyword searching was the most popular searching method among undergraduates compared to the title and author search. ISBN search was observed as an underutilised search field. After the log analysis of OPAC users in Wuhan University, Jiang et al. (2017) identified that patrons heavily depend on simple search interface than the advanced search interface. Also, they observed that users preferred page navigation over modification of search queries when handling search results.

According to the literature review, it is clear that the transaction log analysis is one of the modest research techniques to identify the patrons' communication patterns with OPAC. As Arshad and Ameen (2015) revealed, different kinds of other research methods such as questionnaires, focus groups, and interviews could be combined with transaction log analysis to explore perceptions and preferences of the users. The transaction log analysis results could be used to improve, re-vamp and organise the library collection, services and features of the LMS and OPAC.

Library, University of Moratuwa (UoML) has conducted different studies to identify the patrons' needs, satisfaction, perception and causes of problems in acquiring information from the library. However, these studies do not indicate the users' actual behaviour with OPAC. No previous research has recognised the behavioural patterns of patrons with OPAC of UoML using the transaction log. Therefore, this study aims to conduct an OPAC transaction log analysis to observe the patrons' behavioural patterns and understand the necessary changes needed for LMS, OPAC, and other library services.

Purpose of the study

UoML has conducted various studies such as user surveys, interviews, and discussion forums to identify the user requirements, user satisfaction, user perceptions and users' problems related to accessing information in the library. However, the results of these studies mainly depend on the users' answers provided for questionnaires or interviews. There is a possibility of providing dishonest answers by the participants. Therefore, these studies do not clearly show the actual interaction of the users with OPAC. Transaction log analysis provides the information about the users' behaviour with OPAC without the user being known (Malliari & Kyriaki-Manessi, 2007). The information gathered through the transaction log analysis reflects the pure reactions of the users with OPAC, their knowledge and ability to use it and the failures they experienced. Literature has highlighted many attempts that have been applied to identify the users' behavioural patterns with OPAC using transaction log analysis. This study aims to conduct a transaction log analysis of OPAC to explore the patrons' behaviour with OPAC, observe their searching patterns, and monitor their successes and failures. Also, this study was further focused on identifying the necessary changes needed for OPAC, library user education programmes and other reference services based on the results. A series of questions was formulated to assess these aims, and they became the parameters of the study. The research questions of the current study are:

- Do the academic fields of the users affect the usage of OPAC?
- What are the users' preferred methods of searching OPAC?
- Do the users utilise all the features of OPAC for their searching activities?
- What are the reasons for users' failures in OPAC searching?

Research design

Two kinds of OPAC transaction logs were observed in this study, namely logged transactions, and non-logged transactions. Users'search transactions that have been performed without login into OPAC was considered as non-logged transactions. Meanwhile, users created logged transactions after logging into the OPAC with their user names and passwords. When analysing logged transactions, only the transactions related to undergraduate and postgraduate students of the University of Moratuwa were considered. As a principle, UoML always focuses on enhancing the awareness and skills of the students. Therefore, neither academic staff members nor non-academic staff members' log transactions were accounted for in the study. Also, all the searches performed by developers and testers were excluded from the study.

Under the normal conditions, storing of log files of OPAC was disabled in the UOML server due to the space problem. Considering the requirements of this study, this option was enabled only for a short period to obtain the records related to logged and non-logged users. Accordingly, this transaction log analysis consisted of the records generated from August to October 2019.

The log consisted of both logged and non-logged transactions, and each record contained information such as date and time, type of query, information retrieval method. SQL (Structured Query Language) commands were executed to extract the OPAC log transactions. Extracted data converted into Microsoft Excel. The extracted data were analysed using SPSS 16.0 version.

The Pearson Chi-Square test was used for testing the relationships between categorical variables. The null hypothesis of the Chi-Square test was, no relationship exists on the categorical variables in the population (Kim, 2017).

Findings of the study

All the transactions related to the searching activities of the patrons were stored in a special table called the 'searching history' of LMS. The total number of transactions was 95,340. Out of the total of 95,340 records, 80,994 transaction logs have been created as non-logged transactions. It was observed 14,346 transactions were generated by the patrons after logging into OPAC.

While performing the searching activities, some patrons use the search button several times before loading the result page. This was the reason for generating duplicate

records of the same transaction in the log file. It was considered 78,210 OPAC transaction records of patrons after removing the duplicates. According to the results of the study, the average number of transactions conducted per month was 26,070. This study consisted of two kinds of transaction logs, the average non-logged transactions per month were 22,873, and the average logged transactions per month was 3,197. Higher demand has been indicated for accessing OPAC from the users within the country (average transactions 12,610 per month) and outside of the country (average transactions 8,890 per month).

It was analysed 68,618 records from non-logged transactions after eliminating the duplicate records. As the patrons have not logged into the system, personal information, such as patron category, faculty etc., cannot be traced from these non-logged transactions of OPAC. After eliminating the duplicate records, 9,592 records were analysed as logged transactions.

Types of user categories accessed in the OPAC

Localities of non-logged users could be categorised into three areas: within the institution, within the country and outside the country. Transactions generated within the institution were not counted when analysing the transactions within the country. Out of total non-logged transactions, only 4,116 (6%) transactions have been conducted within the university. A total of 37,831 (55.13%) transactions have been generated within the country, and 26,671 (38.87%) records were observed as transactions accessed outside the country.

Table 1 presents the distribution of transaction logs among undergraduates and postgraduates according to the faculties. Most of the logged transactions were occupied by Undergraduates (97.48%) and the Faculty of Engineering (72.2%). Further, among the logged patrons, the highest number of undergraduates (72.5%) and postgraduates (59.5%) were represented by the Faculty of Engineering.

Table 1

*Category Representation of Logged Transactions*

Category	Faculty				Total
	Architecture	Business	Engineering	IT	
UG	2,043(21.9%)	25(0.3%)	6,785(72.5%)	497(5.3%)	9,350(100.0%)
PG	45(18.6%)	37(15.3%)	144(59.5%)	16(6.6%)	242(100.0%)
Total	2,088(21.8%)	62(0.6%)	6,929(72.2%)	513(5.4%)	9,592(100.0%)

Different types of searches performed by the users

UoML has introduced its LMS with KOHA Open-Source Software to manage the day-to-day library operations. The OPAC of UoML is web-based and runs in any standard web browser. OPAC can be accessed from any part of the world as it is connected with the Internet. Generally, OPAC includes two searching interfaces, simple and advanced. The simple search is the default searching interface which consists of Keyword, Title, Author, Subject, ISBN, Series and Call number as the searching options in a drop-down menu (see Figure 1).

Figure 1

The simple search interface of OPAC
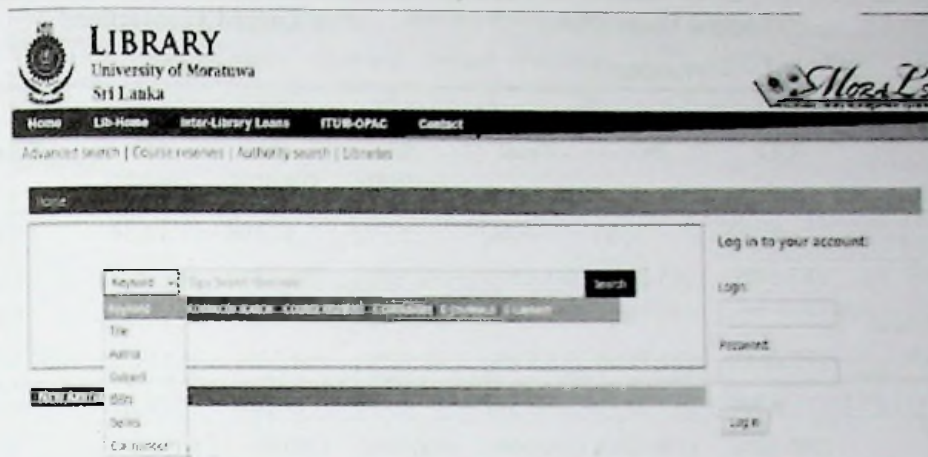
Advanced search interface offers many searching options such as Boolean operators, searching with item-types, searching with library locations, searching by language, searching with the period and searching by document format (Figure 2).

Figure 2

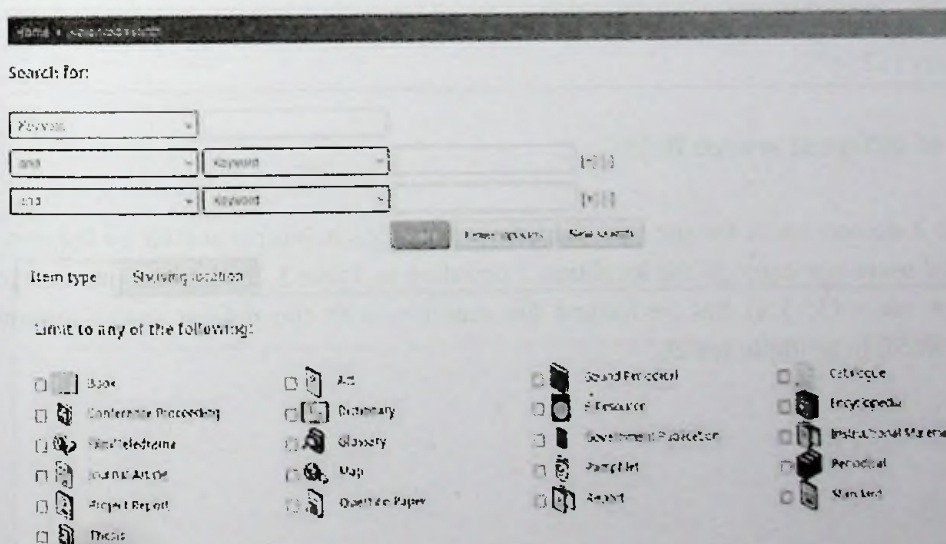*The advanced search interface of OPAC*

Table 2

Use of Simple and Advanced Search by Logged and Non-Logged Users

| Search Type | Logged Transactions | | | Non-Logged Transactions | | | |
| | User category | | | Location | | | |
	UG	PG	Total	Within the Institute	Within the country	Outside the country	Total
Simple search	7,624	158	7,782	3,792	32,798	12,547	49,137
	(81.54%)	(65.29%)	(81.13%)	(92.13%)	(86.70%)	(47.04%)	(71.61%)
Advanced search	1,726	84	1,810	324	5,033	14,124	19,481
	(18.46%)	(34.71%)	(18.87%)	(7.87%)	(13.30%)	(52.96%)	(28.39%)
Total	9,350	242	9,592	4,116	37,831	26,671	68,618
	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)

As shown in Table 2, the simple search interface was the most popular searching interface for logged users (81.13%) and non-logged users (71.61%). Transactions executed by undergraduates using the simple search interface (81.54%) were predominant compared to postgraduates. However, postgraduates have highly utilised the advanced search than undergraduates. Non-logged users within the institution have the highest usage of simple search interface (92.13%), followed by the users within the country (86.7%). Nevertheless, this has significantly changed for the transactions performed outside the country. The advanced search option was the most popular search mechanism for the users who accessed OPAC outside the country (52.96%).

Use of different search fields

Table 3 demonstrates the use of different search fields in simple search by the non-logged users compared to the localities. According to Table 3, the highest percentage of the users (35.5%) has performed the searches with the default search option (Keyword) in a simple search.

Table 3

Use of Different Search Fields in Simple Search Interface by Non-logged Users

| Location	Simple search options								Total
	Author	Series	Keyword	Subject	Publisher	Call number	ISBN	Title	
Within the institution	199 (5.25%)	258 (6.8%)	113 (2.98%)	14 (0.37%)	30 (0.79%)	17 (0.45%)	10 (0.26%)	3,151 (83.1%)	3,792 (100%)
Within the country	13,232 (40.34%)	144 (0.44%)	11,743 (35.81%)	2689 (8.2%)	2195 (6.69%)	29 (0.09%)	4 (0.01%)	2,762 (8.42%)	32,798 (100%)
Outside the country	3,841 (30.61%)	13 (0.11%)	5,613 (44.74%)	2,423 (19.31%)	310 (2.47%)	3 (0.02%)	3 (0.02%)	341 (2.72%)	12,547 (100%)
Total	17,272 (35.1%)	415 (0.8%)	17,469 (35.5%)	5,126 (10.4%)	2,535 (5.1%)	49 (0.1%)	17 (0.04%)	6,254 (12.7%	49,137 (100%)

The title field was the highly preferred search option for the users accessed within the institution (83.1%). Searching with the author was the most popular option among the users within the country (40.34%). Moreover, the keyword was the most popular option among users outside the country (44.74%).

Using different search options in the simple search was identified after analysing the logged user transactions is displayed in Table 4. According to Table 4, most undergraduates (66.3%) and postgraduate students (64.6%) have used the keyword field to search in the simple search interface. Results revealed that postgraduates and undergraduates utilised author and subject fields after the keyword option.

Table 4

Usage of Different Search Fields in a Simple Search by Logged Users

Field	Category		Total
	UG	PG	
Keyword	5,057 (66.3%)	102 (64.6%)	5,159 (66.3%)
Title	1,418 (18.6%)	21 (13.3%)	1,439 (18.5%)
Author	684 (9.0%)	25 (15.8%)	709 (9.1%)
Subject	311 (4.1%)	10 (6.3%)	321 (4.1%)
Series	32 (0.4%)	0 (0.0%)	32 (0.4%)
Call number	122 (1.6%)	0 (0.0%)	122 (1.6%)
Total	7,624 (100.0%)	158 (100.0%)	7,782 (100.0%)

Shelving location was one of the important options available in OPAC, which helps users select the library's materials in a particular location (collection). Several separated locations in the library include lending collection, permanent reference, periodical collection, Sri Lanka collection, thesis collections, etc. If the users require the materials for borrowing, they should select lending collection as the location. Then they would receive the information of the materials which were available in the lending collection only.
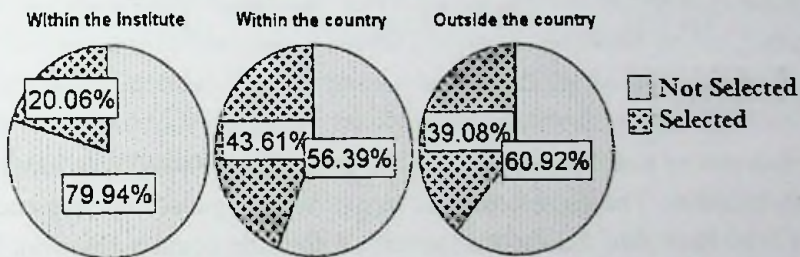
Figure 3

Use of Shelving Location Option in Advanced search by non-logged users

footer: 187
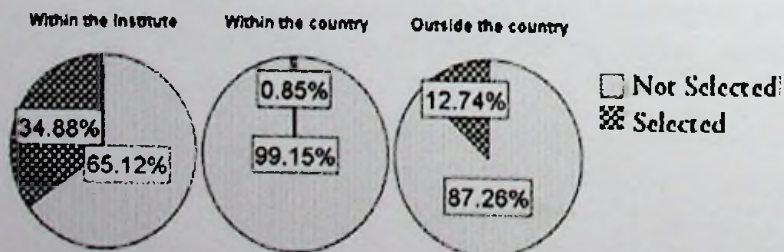
According to Figure 3, searching with shelving location options in the advanced search interface was not popular among non-logged users. Users within the institution have the highest usage of location options (34.88%) than the users accessed from the other two locations. Many users within the country (99.15%) and outside the country (87.26%) have not used the shelving location option. Among the logged users, 90.5%of postgraduates and 84.8% of undergraduates have not selected the shelving location option in the advanced search.

OPAC has offered the option of selecting the materials according to the type of the material, such as books, periodicals, CDs, DVDs, theses, standards, reports etc. This option allowed the user to select only the required item types limiting the number of search results. As displayed in Figure 4, a higher percentage of non-logged users have not executed their searches with the item type option available in the advanced search interface.

Figure 4

Use of item type option in the advanced search interface by non-logged users

Within the Institute — 20.06% / 79.94%
Within the country — 43.61% / 56.39%
Outside the country — 39.08% / 60.92%

Legend: Not Selected / Selected

Similarly, searching with item type option in the advanced search was not popular among the postgraduate and undergraduate students. The majority of the postgraduates (95.2%) and undergraduates (95.9%) did not prefer to conduct their OPAC searches with item type options.

Success and failure rates of OPAC Search

OPAC searches that resulted in at least one hit per search was considered a successful result. If zero results were obtained for a search, it was considered a failed search. Table 5 indicates that the success rate of simple search (78.9%) was higher among non-logged transactions than the advanced search (58.3%). Pearson

Chi-Square test value (Value= 3019.53, df=1, p=0.000) has confirmed a significant difference in success rates between the searching strategies.

Table 5

Success and Failure Rates of Simple and Advanced Search for Non-Logged Users

Location	Simple Search			Advanced search		
	Fail	Success	Total	Fail	Success	Total
Within the institution	1,515 (40.0%)	2,277 (60.0%)	3,792 (100.0%)	80 (24.7%)	244 (75.3%)	324 (100.0%)
Within the country	6,346 (19.3%)	26,452 (80.7%)	32,798 (100.0%)	1,483 (29.5%)	3,550 (70.5%)	5,033 (100.0%)
Outside the country	2,494 (19.9%)	10,053 (80.1%)	12,547 (100.0%)	6,563 (46.5%)	7,561 (53.5%)	14,124 (100.0%)
Total	10,355 (21.1%)	38,782 (78.9%)	49,137 (100.0%)	8,126 (41.7%)	11,355 (58.3%)	19,481 (100.0%)

The success rate of simple search within the institution (60.0%) was lower than the other two localities. The highest success rate of the simple search was occupied by the users who have directed the transactions within the country (80.7%). This was further confirmed by the Pearson Chi-square test (df=2, Value=882.032, p=0.000), indicating a significant difference among the localities for the simple search. The success rate of advanced search (75.3%) was higher than the simple search (60.0%) among the institution transactions. Meanwhile, the Pearson Chi-square test (df=2, Value=480.4138, p=0.000) confirmed a significant difference among the localities for advanced search. The success rate of the advanced search was less than the simple search in both transactions steered within the country and outside the country.

Table 6

Success and Failure Rate of Simple and Advanced Search for Logged Users

Category	Simple Search			Advanced Search		
	Fail	Success	Total	Fail	Success	Total
UG	2,287	5,337	7,624	388	1,338	1,726
	(30.0%)	(70.0%)	(100.0%)	(22.5%)	(77.5%)	(100.0%)
PG	56	102	158	14	70	84
	(35.4%)	(64.6%)	(100.0%)	(16.7%)	(83.3%)	(100.0%)
Total	2,343	5,439	7,782	402	1,408	1,810
	(30.1%)	(69.9%)	(100.0%)	(22.2%)	(77.8%)	(100.0%)

Results of the study revealed that the success rate of advanced search (77.8%) was higher than the simple search (69.9%) among the logged users' transactions (Table 6). Undergraduates (77.5%) and postgraduates (83.3%) were more successful in advanced search than simple search.

Tables 7 and 8 demonstrate users success rates with different search fields in simple and advanced search interfaces. The Keyword search was the most popular search option in both simple and advanced search interfaces, followed by the Author, Title and Subject search options. ISBN search was zero in the simple search. Searching with a Call Number (Classification number) has indicated a higher failure rate in simple and search interfaces.

Table 7

Success and Failure Rates of Search Fields in Simple Search

Searching Status	Simple search fields					
	Keyword	Author	Title	Subject	Series	Call number
Fail	1456	421	312	150	20	110
	28.2%	29.3%	44.0%	46.7%	62.5%	90.2%
Success	3703	1018	397	171	12	12
	71.8%	70.7%	56.0%	53.2%	37.5%	9.8%
Total	5159	1439	709	321	32	122
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 8

Success and Failure Rates of Search Fields in Advanced Search

Status	Advanced search fields					
	Keyword	Author	Subject	Title	ISBN or ISSN	Call number
Fail	113	175	30	54	121	22
	21.4%	23.1%	34.1%	22.9%	38.9%	73.3%
Success	414	583	58	182	190	8
	78.6%	76.9%	65.9%	77.1%	61.1%	26.7%
Total	527	758	88	236	311	30
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Discussion

In this study, a series of questions was designed to analyse the users' searching behaviour with OPAC, which could help identify the modifications required for OPAC, library user education programmes, and reference services.

Effect of academic field on the use of OPAC

Faculty of Engineering has the highest usage of OPAC among the logged transactions. Most probably, the largest student population of the university has led to this result. As the Faculty of Business was new, it consisted of the present smallest student population. Therefore, the Faculty of Business has shown the lowest usage of OPAC. The use of OPAC was extremely poor among the students in the Faculty of IT, though it had a similar student population as the Faculty of Architecture. The main information gathering channel was not the library for IT students as they were experts with computers, the Internet, and modern ICTs.

According to Punchihewa et al. (2018), UOML has introduced different user education programmes for undergraduates and postgraduates to enhance OPAC awareness in fulfilling their information needs. But with the results of the current study, the effectiveness of the user education programmes was questionable. The library should continuously emphasise the students regarding the importance of using OPAC for their information access. This could be achieved through various

promotional activities such as user awareness workshops, leaflets, discussion forums or chat services, social media etc.

User's preferred methods of searching the OPAC?

The interface design was directly related to the success of the searching activities in OPAC. It has also influenced the selection of the type of search to be executed. The OPAC of UOML consisted of two interfaces: the simple search interface and the advanced search interface. The simple search interface was the first searching interface that the patrons could find. Keyword, Title, Author, Subject, ISBN, Series and Call number were the search options in the simple search interface that appeared in a drop-down menu. The interface of the advanced search was much complicated, with many searching options. It also had several drop-down menus, which included all the simple search options. These drop-down menus could be combined using Boolean operators. Other than this field combination, several search options like 'Item type', 'Publication date', 'Language', 'Shelving location', 'Audience' and 'Sorting' etc.

Both logged users and non-logged users depended on the simple search interface for their information-seeking activities. The undergraduates have performed simple search activities than postgraduates (among logged users). On the other hand, users within the institution and within the country *have resulted* in a higher percentage of simple search OPAC transactions among the non-logged user categories.

The library should critically analyse the heavy use of simple search by these user groups though there were many options in advanced search for a perfect searching. As the simple search interface was the default search option in OPAC, most logged and non-logged patrons may have used simple search. Malliari and Kyriaki-Manessi (2007) have explained that many users hesitate to change the default search options provided in OPAC if they are not experienced or technically sound enough to use the advanced search options. Lack of skills and knowledge in constructing proper combinations of the options may be another reason for the minimal use of advanced search.

The main objective of steering searches in the advanced search was obtaining the accurate, most relevant limited number of results by using the filtering options. Postgraduates have more experience in their specialised fields and are more aware of the process of information searching compared to undergraduates. Their searches were based on experience, and they have realised the advantages of conducting

OPAC searches with advanced search. Therefore, postgraduates have shown comparatively higher usage in advance search than undergraduates.

Utilisation of the featured of OPAC for searching

As the results revealed, most undergraduates, postgraduates and patrons within the institution have executed their searches mainly with the 'Keyword' option in a simple search interface. Several factors were observed in this study as the potential reasons for the dominance of keyword search. The Keyword appeared as the default option in OPAC simple search interface. Patrons must actively select a new search term from the drop-down box to change the default option. Malliari and Kyriaki-Manessi (2007) indicated that users were very reluctant to change the default choice, except for those considered 'experienced'. Therefore, this situation has influenced many patrons to select Keywords as their main search term as it appears first. Further, any typical word could be applied without depending on the controlled vocabulary with Keyword search. These factors would have led to selecting Keyword search by most users in their OPAC searching activities.

'Title' and 'Author' were the second and third popular searching options among the patrons. Most OPAC users preferred 'known-item' searching, which facilitates the searches using the title or author of the documents. When performing a search with a known-item, users knew beforehand what they were looking for. They could be more likely to search with known authors or titles in their subject areas, considering this type of searches were easier and safer.

Further, the results revealed that patrons have less priority in searching with 'Subject'. Searching with 'Subject' could be categorised as 'unknown item' searching, which the users conduct searches without knowing the existence of certain items in a particular subject area. This type of search required some basic searching skills in handling search engines, knowledge in terminologies, and some experience combining subject areas. Users' unfamiliarity with the terminology (subject headings) used by the library, the inability of expressing the subject with proper keywords and lack of knowledge of the system's capabilities were the main reasons for the minimal usage of subject term search.

The search terms like ISBN were not much familiar for the general OPAC users. Though the ISBN could be considered a known item', it was not a term that general users can easily remember. The search terms such as publisher and call number were also not popular among the users as these were not familiar to the users. Searching

with ISBN, Publisher, and the Call Number was usually performed by the information professionals and the library staff but not by the general library users.

Among the many options offered in the advanced search interface, searching by the 'Shelving location' option was a non-prominent searching field among the users. The reason for not using the shelving location option by the users within the country and outside of the country was their absence of the need to reach the library shelves physically. Unawareness of library locations and available resources may be why undergraduates and postgraduates are not using the shelving location option within the university.

Searching with 'Item type' (Figure 5) was another least utilised option in the advanced search. This was mainly due to the users' unawareness of the item types available in the library. Also, users have not identified the advantages of acquiring only the required item types for their searches rather than receiving all the types of materials available in the library.

Reasons for failures in OPAC Searching?

Hunter (1991) mentioned that all the zero hits that appeared in the transaction log do not represent the patrons' inability of searching. They may have performed the search correctly, but patrons may receive zero hits due to the unavailability of the searched item in the database. Although this limitation was in the current study, Hunter (1991) has further indicated that this definition of zero hits in the transaction logs could be used to identify the search failures of the patrons up to some extent.

Users who have accessed OPAC within and outside of the country were highly successful in performing searches in the simple search. They had no opportunity to participate in any of the training sessions on OPAC searching conducted by UoML. Therefore, they lacked the skills and knowledge to perform successful searches with advanced search to obtain the desired search results. Furthermore, undergraduates, postgraduates and users who accessed the OPAC within the institution were remarkably successful in performing searches in the advanced searching interface. Many users in these user categories may have acquired the basic knowledge for handling OPAC through UoML training sessions, library guides and discussions. This may be the reason for a higher success rate with advanced search for them.

The result of the study has indicated a significant difference in the success of searches with Keyword, Author, Title, Subject, ISBN, and other searching fields. The

highest success rate was performed with Keyword. When the user enters a term in the 'Keyword' field, the system searches it everywhere in the catalogue, ensuring desired results. The most important feature in Keyword searching was the possibility of using any typical word without depending on the controlled vocabulary.

Searches executed with Author and Title are considered as 'known term' searching. But as the titles have more words, there was a higher tendency to diminish the success level. Users' unfamiliarity with library terminology was the main reason for the failures in searching with the subject. Generally, users preferred to select plain, everyday terms as their subject terms to construct the search queries. The library has introduced the subject terms from a controlled vocabulary of subject headings. As explained by Malliari and Kyriaki-Manessi (2007), this artificial terminology was unfamiliar to the users. The users' everyday language did not match with the terms assigned by the librarians as the subject terms. These reasons have resulted in a lower success rate for the searches conducted with the subject term. Furthermore, the main observation for the failures in OPAC search with ISBN was entering other numbers or words instead of correct ISBN.

Conclusion and Recommendations

Libraries should always focus on identifying the actual needs, behaviour, preferences, and habits of OPAC users as it directly helps to make decisions on the development of OPAC systems. The study results revealed that patrons preferred to use the simple search interface over the advanced search interface. The Keyword search was the most popular searching option of the patrons in the simple search, and many filtering options provided in the advanced search interface were not utilised. Based on the observations, the library should redesign its user education programmes for providing better awareness, knowledge, and skills for patrons to conduct effective searches with OPAC. The library should encourage the academic departments to send more students (both undergraduate and postgraduate) to participate in library user education programmes. Also, the library should provide continuous education for the patrons on information literacy to improve their skills in retrieving information from OPAC or any other online information source.

The structure and the interface of the OPAC should be changed to satisfy the users and meet their information requirements. It is suggested to provide feedback to the users when they retrieve zero hit search. Also, OPAC should be redesigned to adapt the natural language familiar to the users to obtain the same results as controlled vocabulary subject headings provide. Also, it should not be allowed to insert words

in numeric searches such as ISBN. Online help facilities should be provided with precise answers and examples. In addition to these programmes, the library should offer on-site help to the new users and establish a help desk.

Based on the findings, library managers should realise the importance of analysing the OPAC transaction log from time to time. Therefore, increasing the storage capacity of the LMS server is one of the essential requirements. This will allow storage of the users' OPAC log files at least for a given period.

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