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Use of Bioinformatics Resources and Tools by Users of Bioinformatics Centers in India

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Abstract

Information plays a vital role in Bioinformatics to achieve the existing Bioinformatics information technologies. Librarians have to identify the information needs, uses and problems faced to meet the needs and requirements of the Bioinformatics users. The paper analyses the response of 315 Bioinformatics users of 15 Bioinformatics centers in India. The papers analyze the data with respect to use of different Bioinformatics databases and tools used by scholars and scientists, areas of major research in Bioinformatics, Major research project, thrust areas of research and use of different resources by the user. The study identifies the various Bioinformatics services and resources used by the Bioinformatics researchers.

Keywords: Informaion services, Users, Inforamtion needs, Bioinformatics resources

1. Introduction

'Needs' refer to lack of self-sufficiency and also represent gaps in the present knowledge of the users. Apart from the expressed or articulated needs, there are unexpressed needs which the user is aware of but does not like to express (Devadason & Lingam, 1996). Information needs is a complex process. 'Information' is put to different uses and 'Need' is satisfied by having access to the identified information in a particular package and form, and at a suitable time. The complexity with 'information needs' lies with the troublesome concept 'information'. When the term 'user study' is employed the specific sub-field should be specified, and the aspect or aspects of 'information' under consideration should be defined. The purpose of a library and an information system is to fulfil the users' needs and requirements for documents and information. Such needs may be related to educational activities, research activities, professional activities, recreational activities, cultural activities or personal development. Information needs should not be confused with information seeking behaviour. What users believe they need is represented in the subjective understanding of needs. This subjective understanding is reflected in their information seeking behaviour. Even if this behaviour may be studied objectively it is still not useful as criteria for what is needed. What is needed is something that is able to solve the problem behind the users' behaviour. The word 'information' is used, in the context of user-studies research. There is notmuch effort in research and writing of user studies that has circumstances in information science apart from information retrieval. The probable interrelationships among personal needs and these other factors aim is to suggest that when we talk about users' information needs we should have in mind some conception of information (facts, data, opinion, advice) as one means towards the end of satisfying such fundamental needs (Wilson 1981).

Information plays a vital role in bioinformatics to achieve the existing bioinformatics information technologies. Librarians have to identify the information needs, uses and problems

faced to meet the needs and requirements of the bioinformatics users.In the present age of information, it has been increasingly felt that to serve users better, information needs and uses must become the central focus of attention. It is beyond doubt that the success of the information service is more likely to be achieved by adjusting the services to meet the specific needs of an individual or a specific group rather than trying to adopt the user to match with the output of the information system. We have to create and develop the user-oriented system for their maximum information satisfaction. In recent years, there have been several studies pertaining to users and their information needs.

Information is recognised as a national resource, which is of vital significance in all sectors of human endeavour - planning, decision making, research and development, education, socio-economic and cultural development, and also in improving the quality of life of every members of the society. Along with the material and energy, information is considered a potential resource, a product and there by a need, which must be put to use effectively. It is true that the information scientists had for a long time neglected one of the most important components of any information system, namely the 'user'. They were more concerned with the information and their bibliographical organisation and control. It is also true that this organisation was ultimately meant to satisfy the information needs of users. How exactly the user behaved when he was looking for some information, what type of information was used in which situation, how the information was used when obtained, all these were not very clearly known to the information scientists? So, for the proper and systematic planning and development of information resources and services the user studies are very essential.

The present study is aimed at ascertaining the information needs of Bioinformatics Users. It is essential in designing information systems and in building up need based information centers. The study follows an exploratory design. It focus on needs, uses, identification and various problems arising out of it, especially in the context of information; be it related to information technology or management problems in the process of information. Users study, research has contributed to a better understanding of information needs and uses among the users in Bioinformatics.

2. Literature reviews

Yoon and Kim (2014) investigate the international graduate students' internet use in the context of seeking health information because according to them, the internet is a useful and primary source for health information, especially by foreign-born students. Chen (2014) studied the information needs and information sources of family caregivers of cancer patients. The finding shows that family caregivers' information needs varied along the cancer journey, and they used various information sources to satisfy these needs. Demographic variables affected the information-seeking behaviour of the family caregivers. Du and Song (2013) study the information needs analysis of the aerospace discipline. The findings indicate that journals are the most important information resources. While 20 per cent of cited journals were discipline-specific, 80 per cent were in related fields. To provide for aerospace research, a library collection needs to include the databases of the field, and commercial and open access journals that cover aerospace engineering, related disciplines and the sciences in general. Catalano (2013) revealed that graduate students begin their research on the internet much like any other information seeker, consult their faculty advisors before other people, and use libraries in diverse ways depending on the discipline studied. He noted the difference between doctoral and master's students. It indicates that information behaviour research conducted on graduate students should define between masters' and doctoral students. Further, the findings inform both academic librarian and faculty practice as to how and to assist students with their research by helping them to understand how students typically approach research. Robson and Robinson (2013) study shows that library and information science focus on information seeking

and the information user, while those from the field of communications focus on the communicator and the communication process. A new model is proposed that includes key elements of existing models and takes into account not just the information seeker but also the communicator or information provider. Sahu and Singh (2013) study shows that differences in information seeking behaviour and needs for various academic is the sub-fields of Indian astronomy or astrophysics, and highlights the value of information seeking behaviour to scientists working in astronomy or astrophysics. The study concludes that astronomyor astrophysics academics were making use of the Astrophysics Data System followed by their use of e-archives for education and research. The findings underscored the need to continue accessing specialised needs to find innovative solutions.

Parves (2012) study shows that corporate managers are in constant need of current and trustworthy information quickly. After he conducted an interview of 352 managers working in financial institutions in India, the choice of managers' specific type of information is financial and industry specific databases which is in electronic format. Therefore, the format preferred by the manager was faster communication and it was found to be the electronic format of databases. Savolainen (2012) studied the conceptualisations of task-based information needs, approached the motivators for information seeking in terms of the informational requirements posed by tasks at hand. However, the ways in which such needs trigger and drive information seeking have not been specified in detail. Expectancy-value theories provide a more elaborate picture of motivational factors by focusing on actors' beliefs about the probability of success in information seeking and the perceived value of the outcome of this activity.

Beautyman and Shenton (2009) in their study explore the nature of school students' inspired information wants. It considers how such wants arise and actions taken by youngsters to meet them through their information needs. The findings have a range of implications, notably for practices in both education and Library and Information Science. Kumar (2009) analyses the information needs and use pattern among faculty members and research scholars of Chaudhary Charan Singh University, Meerut's university campus and six district colleges. This study raises awareness of the collections and services of the library, and shows the effectiveness of resources and services of college libraries and the university library. It focuses on the skills needed to use electronic resources and emphasises the need for user education and training in using electronic sources in the library based on user responses.

Miranda & Tarapanoff (2007) deal with the identification of the information needs and information competencies of a professional group. Information needs were closely linked to the needs of the work processes and that the competencies developed to attend these needs were closely related to the success factors. Webber and Zhu (2007) investigate the question of how Chinese young adults (18-26 years old) in Sheffield seek employment information, and what sources and channels they use. Fifty five percent of the respondents felt that they had encountered barriers when seeking information. The largest number of employed respondents had used newspapers and magazines to find their current job, which was also the channel that the largest number would recommend to a friend. However, the Internet was the respondents' favorite and most widely used channel and they perceived both advantages and disadvantages in using it for job seeking.

3. Methods

3.1 Objecties

- To identify the use and adequacy of channels of information sources that varies with every Bioinformatics user.
- To find out the various Bioinformatics specific databases and tools used by users.
- To identify the various Bioinformatics services and resources used by the Bioinformatics researchers.

- To identify the problems that researchers experience in obtaining required information to keep up to date with advancement in their field of study.
- To assess the level of satisfaction of the Bioinformatics users after acquiring their information needs and requirements.
- To assess the impact of training and workshops given by resources centres on usage of bioinformatics resources by users and uptodateness of users

3.2 Scope

The study population is selected based on stratified random sampling upon the Bioinformatics users in select Bioinformatics centers and libraries in India. It comprises research scholars, scientists, faculty members and those who use the libraries regularly for meeting their information needs and requirements in Bioinformatics. Total 450 questonnaire were distributed among the different types of Bioinformatics users, out of which 315 have been received. The users from following Bioinformatics Centres have been surveyed:

- BIC-DBT (Bioinformatics Centre at Department of Biotechnology), New Delhi.
- BIC-ICMR (Bioinformatics Centre at Indian Council of Medical Research), New Delhi.
- BIC-IISc (Bioinformatics Centre at Indian Institute of Science), Bangalore.
- BIC-NII (Bioinformatics Centre at National Institute of Immunology), New Delhi.
- BIC-PU (Bioinformatics Centre, Pondicherry University), Pondicherry.
- BIC-UP (Bioinformatics Centre at University of Pune), Pune.
- BII (Bioinformatics Institute of India), Noida.
- CCBB-JNU (Centre for Computational Biology and Bioinformatics at Jawaharlal Nehru University), New Delhi.
- CDFD (Centre for DNA Fingerprinting and Diagnostics), Hyderabad.
- DPMB (Rice Genome Initiative Department of Plant Molecular Biology), New Delhi.
- IBAB (Institute of Bioinformatics and Applied Biotechnology), Bangalore.
- NBRC (National Brain Research Centre), Gurgaon.
- NIPGR (National Institute of Plant Genome Research), New Delhi.
- SCFBio-IITD (Super Computing Facility for Bioinformatics and Computational Biology at Indian Institute of Technology Delhi), New Delhi.
- TCGA-IGIB (The Centre for Genomic Application-Institute of Genomics and Integrative Biology), New Delhi.

3.3 Methods

This study was exploratory in nature; therefore both quantitative and qualitative methodological tools were employed. Aquestionnaire survey was conducted which was followed by interview in spite of the users heavy and tight schedule. The questionnaire was intended to elicit the nature and type of information that bioinformatics users needs and uses in order to carry out their research and based on the objectives of the study. It also sought to ascertain what information resources and services they would find useful to accomplish their information needs. Questionnaires were distributed among the libraries attached with Bioinformatics Centre (BIC) and within the BIC itself by means of a personal visit to the libraries and research centers. Those bioinformatics users who are not available in the time of distribution are communicated through e-mail and registered post. Questionnaire has been distributed to PhD scholars, scientists and faculty members.

The collected data is arranged, analysed and interpreted by using Microsoft Word and Excel 2007 software package in computer for text and tables presentation. The main purpose of employing statistical method is to draw inferences and test the hypotheses that were formulated

and also to fulfil the stated objectives of the study. A chi-Square test technique is used in drawing interpretations for the opinion about the bioinformatics services and resources.

4. Data analysis and interpretation

4.1 Profile of the bioinformatics user

Four hundred and fifty questionnaires were distributed among the bioinformatics researchers, out of which 315 users return the questionnaire with a response rate of seventy percent (70%), whereas thirty percent (30%) did not return the questionnaire.

The user profile comprises of the number of survey response, demographic like; gender, age group, user group (PhD scholars, scientists and faculty) and their subject background. Table 1 show that male (163, 52%) respondents are higher than female (152, 48%) respondents. In general, respondents were middle aged with the majority of 65% (32%+33%) falling in the combined aged group of 21-40 years. The next largest age group i.e. 95 (30%) were 41-50 years age groups. Only 17 (5%) of the 315 respondent were under 51-65 years age group which were the faculty members in the bioinformatics centre.

User group study indicates that there are 5% faculty and 95% (64%+31%) research scholars and scientists. Biology subject background (34%) is found to be the maximum respondents. The other subject background is: Mathematics, Physics, Engineering, Medicine, Pharmacist, Agriculture, etc. The study reveals that young researchers are more responsive than the senior researchers.

Table 1. Users Profile

No.	Users Profile		No. of Response	Response in %
1	Survey Response		315	70
2	Gender	Male	163	52
		Female	152	48
3	Age Group	21-30	100	32
		31-40	103	33
		41-50	95	30
		51-65	17	5
4	User Group	Faculty	17	5
		Research Scholars	201	64
		Scientists	97	31
5	Subject Background	Biology	107	34
		Computer Science	63	20
		Chemistry	72	23
		Statistics	52	16
		Others	21	7

4.2 Purpose of using library

Table 2 depict the purpose of using the library which indicates majority (86%) of the users used the library for education, 66% and 63% use for research needs and current information respectively. Whereas the rest 14% used it for reference acquisition and recommendation of documents, be it books, journals, print and online and discussion with the librarian. Maximum of the users visit the library weekly (53%), whereas 27% and 20% visit daily and in their convenient time. Users who use the library weekly use in evening time (35%) and the rest used in morning (33%) and in their convenient time (32%).

Table 2. Purpose of using library

No.	Use of Library	No. of Response	Response in %

1	Purpose	Education	272	86
		Research Needs	209	66
		Current Information	200	63
		Others	44	14
2	Frequency	Weekly	168	53
		Daily	84	27
		Others	63	20
3	Timing	Evening	110	35
		Morning	104	33
		Others	101	32

From the analysis we can conclude that, there is not much variation in the timing of using the library by the users. Therefore, the analysis reveals that most of the users used the library in their convenient time.

4.3 Library services used

Researchers used library services for different purposes based on the requirement of information they need. Here, the types of library services used by them are displayed in table 3 with multiple choices of answers permitted. The study shows that the widely (97%) used library service is Internet and Intranet, whereas Document Delivery Services and DeLCON (DBT-Electronic Library Consortium) E-Resources is used by 36% users.

Table 3. Library services used

No.	Types of Library Services	No. of Response	Response in %	Rank
1	Internet & Intranet	305	97	1
2	OPAC	275	87	2
3	Abstracting and Indexing Services	270	85	3
4	News Paper Clipping Services	260	83	4
5	Inter Library Loan	250	79	5
6	Current Awareness Services	215	68	6
7	Reprographic Services	215	68	6
8	Circulation of books	209	66	7
9	E-Resources	205	65	8
10	Circulation of periodicals	200	63	9
11	Reference & Consultation	200	63	9
12	Selective Dissemination Services	200	63	9
13	Document Delivery Services	115	36	10
14	DeLCON	115	36	10

Thus, we can observe that the types of library services provided, traditional and modern library services are widely used by the research scholars for their current information, self-update and education. Centralising such services in the library is a natural synergy of interests and enhances the provision of library resources.

4.4 Purpose and frequency of accessing internet

Users access internet for different purpose based on their requirement of what kind of information they urge for. Table 4 shows the frequency and purpose of users' access to bioinformatics services. The study shows that 73% of users' access bioinformatics services frequently whereas 23% access rarely and the rest 13% access depending on their research purpose. A study of the purpose of accessing bioinformatics services reveals that, 100% users

go for e-resources and keeping self-update, marginally followed by 82% accessing bioinformatics services for reference. On the other hand, the other 19% users access for different purpose.

Table 4. Purpose and frequency of accessing internet

No.	Using Internet		No. of Response	Response in %
1	Purpose	E-Resources	315	100
		Keeping self-update	315	100
		Reference	257	82
		Others	59	19
2	Frequency	Often	231	73
		Rarely	71	23
		Others	13	4

From the study we can reveal that those users who use internet access often are more self-update than those who rarely use them for accessing bioinformatics services. This is true in case of accessing online books and journals in which accessing those online resources needs internet access since all the online resources are available in internet through their specified registered IP (Internet Protocol) address.

4.5 Additional facilities required

In this digitised world and india being a developing country, most of the librarires are on their way to digitisation and subscription of electronic resources is the current trend in libraries which is also cost effective. Therefore, users are asked to specify the additional facilities required with multiple choices of answers permitted.

Strong interest was expressed in additional facilities as shown in table 5, which is one hundred per cent of the bioinformatics users required increase holdings of laboratory manuals, handbooks, and other procedure references for updating their research. Similarly 98% of the users required more online access to others databases and reference sources. Ninety five percent of the users' required networked access to current contents and established a collection of research laboratory templates and access to more full-text online journals and books.

Table 5. Additional services required by users

No.	Types of Additional Service	No. of Response	Response in %	Rank
1	Increase holdings of laboratory manuals, handbooks, and other reference material	315	100	1
2	Provide more online access to other databases and reference sources	310	98	2
3	Provide networked access to current contents	300	95	3
4	Establish a collection of research laboratory templates	300	95	3
5	Provide access to more full-text online journals & books	300	95	3

The analysis reveals that libraries must maintain a well-rounded core collection development, including reference material to satisfy the information needs and uses of the bioinformatics users. These may be supplemented through networks, e-resources, library consortium, etc., to achieve better qualitative and quantitative standards. Library collections are dynamic resources therefore, constant renewal of materials/ collections to ensure that the collection remains relevant to the users is essential.

4.6 Core journal of bioinformatics

The list of core journal available in the library was again placed before the users to know their usage as shown in table 6.

Table 6. Core journal of bioinformatics mostly used

No.	Core Journal	Country	No. of Response	Response in %	Rank
1	Bioinformatics	UK	250	79	1
2	BMC Bioinformatics	UK	250	79	
3	Nucleic Acids Research	UK	250	79	
4	Proteomics	Germany	250	79	
5	Journal of Proteome Research	USA	250	79	
6	PLoS Computational Biology	USA	250	79	
7	BMC Genomics	UK	250	79	
8	Proceedings of the National Academy of Sciences	USA	250	79	
9	Proteins: Structure, Function and Bioinformatics	Germany	250	79	
10	International Journal of Molecular Medicine	Greece	250	79	
11	International Journal of Data Mining and Bioinformatics	Switejerland	250	79	
12	International Journal for Computational Vision and Biomechanics	India	250	79	
13	International Journal of Bioinformatics Research and Applications	UK	235	75	2
14	Journal of Computational Biology	USA	235	75	
15	Journal of Computational Intelligence in Bioinformatics	India	235	75	
16	Journal of Integrative Bioinformatics	Germany	235	75	
17	Genome Biology	UK	235	75	
18	Genome Research	USA	235	75	
19	Briefings in Bioinformatics	UK	235	75	
20	Briefings in Functional Genomics and Proteomics	UK	235	75	
21	Computational Biology and Chemistry	UK	232	74	3
22	Journal of Biomedical Informatics	USA	228	72	4
23	Journal of Biomedical Science	UK	225	71	5

Out of the twenty-three journals available, the mostly used core journals of bioinformatics are: Bioinformatics, BMC Bioinformatics, Nucleic Acids Research, Proteomics, Journal of Proteome Research, PLoS Computational Biology, BMC Genomics, Proceedings of the National Academy of Sciences, Proteins: Structure, Function and Bioinformatics, International Journal of Molecular Medicine, International Journal of Data Mining and Bioinformatics and International Journal for Computational Vision and Biomechanics which responded to 79%.

Marginally followed by; International Journal of Bioinformatics Research and Applications, Journal of Computational Biology, Journal of Computational Intelligence in Bioinformatics, Journal of Integrative Bioinformatics, Genome Biology, Genome Research, Briefings in Bioinformatics and Briefings in Functional Genomics and Proteomics which responded to 75%. Similarly, Computational Biology and Chemistry (74%), Journal of Biomedical Informatics (72%) and Journal of Biomedical Science (71%) are also widely used by them.Among the 23 most used journals, Bioinformatics users prefer to study the more foreign origin journals as 10 journals are from United Kingdon followed by USA (6), Germany (3), India (2), Greece and Switejarland

4.7 Types of library resources used

The types of library resources used by the bioinformatics researcher's vary from one researcher to another based on the information they required, which are presented in table 7 against the response received from the users. The study shows that, the mostly used library resources by bioinformatics researchers is electronic resources with overwhelming majority of the response i.e. 82% whereas 61% users prefer both, i.e. online and print, and 40% users prefer print resources. The tertiary source of information or reference material such as; Encyclopaedia, Atlas, Dictionary, etc. is used by 36%. On the other hand, other type of library collection E-Database is used by 35% respondent.

Table 7. Types of library resources used

No.	Library Resources	No. of Response	Response in %	Rank
1	Electronic resources	257	82	1
2	Both (Online& Print)	193	61	2
3	Print	125	40	3
4	Encyclopaedia, Atlas, Dictionary, etc.	112	36	4
5	Others: E-Database	110	35	5

The analysis reveals that in today's electronic environment, researchers feel more convenient in using electronic than print resource for acquiring their information needs in bioinformatics. The study also indicates that investing in a dynamic and responsive online library can achieve major gain in efficiency in a research setting because it facilitate information gathering easier as well as save the time of the users and library personnel.

4.8 Source of acquiring bioinformatics resources

Users required various sources of information for conducting research. The source of acquiring bioinformatics resources are categorised in nine parameters as shown in table 8 with multiple choices of answers permitted.

Table 8. Source of acquiring bioinformatics resources

No.	Source of Acquiring Bioinformatics Resources	No. of Response	Response in %	Rank
1	Reading of review articles	313	99	1
2	Workshop, conference, symposium, etc.	313	99	1
3	Own research	310	98	2
4	Access to sequence analysis software	310	98	2
5	Accessing of bibliographic databases from library	310	98	2
6	Printed and electronic media	310	98	2
7	Personal contacts with other researchers or	307	97	3

	discussion with colleagues			
8	Access to library services	175	56	4
9	Contact with Information professionals in geographic areas	25	8	5

The study reveals that reading of review articles and workshop, conference, symposium, etc., response to 99% is the major source used for acquiring bioinformatics resources. This is marginally followed by own research, access to sequence analysis software, bibliographic databases from library or laboratory computers and printed and electronic media response to 98% each. Personal contacts with other researchers or discussion with colleagues 97%, access to library services 56% and contact with information professionals in geographic areas 8% are the desired source of acquiring bioinformatics resources by the users.

4.9 Opinion about bioinformatics services and resources

Rating refers to expression of judgment or opinion grading a phenomenon (an object or person) in terms of specified criteria. The users are expected to rate each elements (Agree, Depends and Disagree) separately in terms of specified criteria by selecting a numerical rating that is offered to him which is presented in table 9. These opinions are the main assumptions framed for the study of the information needs and uses of bioinformatics users of select libraries in India.

Table 9. Opinion about bioinformatics services and resources

No.	Assumptions	Criteria	O	E	O - E	$(O - E)^2$	$(O - E)^2/E$
1	The information needs and uses in bioinformatics will only increase if the level of new bioinformatics systems grows	Agree	300	290	10	100	0.34
		Depends	10	15	-5	25	1.67
		Disagree	5	10	-5	25	2.50
		Critical Value = 5.99. **X^2 = 4.51**					
2	Information services assist users in identifying and utilising of bioinformatics tools	Agree	297	300	-3	9	0.03
		Depends	15	10	5	25	2.50
		Disagree	3	5	-2	4	0.80
		Critical Value = 5.99**X^2 = 3.33**					
3	Staff development programme for bioinformatics users enable them to develop multidisciplinary skills	Agree	175	180	-5	25	0.14
		Depends	121	120	1	1	0.01
		Disagree	19	15	4	16	1.07
		Critical Value = 5.99**X^2 = 1.22**					
4	Bioinformatics services of the library/ centre will greatly depends on the level of available subject specific expertise	Agree	180	200	-20	400	2.00
		Depends	107	90	17	289	3.21
		Disagree	27	25	2	4	0.16
		Critical Value = 5.99**X^2 = 5.37**					

The Chi-Square Test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more data and to determine the accurate responds.

The study reveals that, the first assumptions testing Chi-Square value i.e. $X^2 = 4.51$ is less than the level of significance i.e. 5.99. Therefore, 4.51< 5.99; hence, the hypothesis 'The information needs and uses in bioinformatics will only increase if the level of new bioinformatics systems grows' is accepted which is also supported by table 3, table 4, table 5 and table 11.

Similarly, the second opinion'Information services assist users in identifying and utilising of bioinformatics tools' is accepted as the Chi-Square value $X^2 = 3.33$ is less than the level of significance i.e. 5.99 (3.33 < 5.99). This assumption is supported by table 4, table 8, table 14 and table 15. Performing internet access for bioinformatics and the types of information used such as; Review full text articles on a particular subject, State-of-the-art review article, the Authentic source of information and using multimedia files utilised in identifying bioinformatics tools.

Likewise, the third assumption 'Staff development programme for bioinformatics users enable them to develop multidisciplinary skills' is accepted due to the Chi-Square value$X^2 = 1.22$ is less than the level of significance i.e. 5.99 (1.22 < 5.99), which is supported by table 4, table 8, table 14 and table 15. The workshops, seminars, conferences and continuing education and internet clearly reflected intense interest in the database connections, and the need for structures to be exploited further to facilitate use of the massive amount of biological data being encoded.

Finally the fourth hypothesis 'Bioinformatics services of the library/ centre will greatly depends on the level of available subject specific expertise' is partially accepted because the Chi-Square value$X^2 = 5.37$ and the level of significance i.e. 5.99 (5.37 < 5.99) is very less in difference. This opinion is supported by table 5 and table 17.

Interpreting the assumptions using the Chi-Square test, we can conclude that as the primary role of the library has shifted from an information repository to portals, the need for specialized subject expertise has both broadened and intensified. Few librarians have the training or experience that would enable them to provide a full range of bioinformatics services.

4.10 Use of bioinformatics database

Users are asked regarding the frequency of using the bioinformatics databases available in their research centre and library. The study of the use of bioinformatics database shown in table no.10 reveals that; NCBI, GenBank, Entrez, SWISS-PROT, MEDLINE, PDB, EBI, Geneworks, PubMed and SCOP 315 each and 310 are the maximum bioinformatics database used, followed by PROSITE, Pune-Net, CCSD, ENZYME, PIR, REM-TrEMBL, EMBL, Tremblnew, MtbSD, FSSP, PRODOM and PepConfDB. These databases allow bioinformatics researchers to limit their search by acquiring authentic information and full text article. Therefore users made use of only certain databases to retrieve the documents they required.

Table 10. Use of bioinformatics database

No.	Rank	Bioinformatics Database	No. of Response	Sl.No.	Rank	Bioinformatics Database	No. of Response
1.	1	NCBI	315	25.	14	SP-TrEMBL	87
2.	1	GenBank	315	26.	15	MGDD	88
3.	1	Entrez	315	27.	16	IMEx	61
4.	1	SWISS-PROT	315	28.	16	SilkSat	61
5.	1	MEDLINE	315	29.	16	Predict Regulon	61
6.	1	PDB	315	30.	17	InSatDB	53
7.	1	EBI	315	31.	17	PlasmoAlign	53
8.	1	Geneworks	315	32.	17	EcoFunPPI	53
9.	1	PubMed	315	33.	18	CHPVDB	52
10.	2	SCOP	310	34.	18	PROSITEDOC	52
11.	3	PROSITE	295	35.	19	PRINTS	47
12.	4	Pune-Net	290	36.	20	VirGen	47
13.	5	CCSD	250	37.	21	PFAM	45
14.	6	ENZYME	217	38.	21	InterPro	45

15.	7	PIR	215	39.	22	Biotech Directory	40
16.	8	REM-TrEMBL	141	40.	22	DDTRP	40
17.	9	EMBL	137	41.	23	PAR 3D	35
18.	10	Tremblnew	136	42.	23	MICAS	35
19.	11	MtbSD	130	43.	23	S-Star Alliance	35
20.	12	FSSP	125	44.	24	MGEXdb	21
21.	12	PRODOM	125	45.	24	PLecDom	21
22.	12	PepConfDB	125	46.	24	RManager	21
23.	13	AVIS	98	47.	24	GEN 2 PHEN	21
24.	13	IMGT	98	48.	24	IMGTHLA	21

4.11 Selection of bioinformatics database in libraries

In fact library is a non-profit organisation with limited source of funds. Therefore librarians'attempt to select the bioinformatics database on user's point of view and taking their opinion based on the satisfaction of their needs and requirements.

Table 11. Selection of bioinformatics database in libraries

No.	Category	Agree	Depends	Disagree
1	Cancel duplicate print subscriptions if electronic database is available	300	6	9
2	Subscribe to only the electronic versions of new database titles	300	6	9
3	Cancel lesser used print database	295	10	10
4	Place fewer new subscriptions to print database	251	44	20
5	Financed additional electronic database by 'pay per use' (users pay per article accessed)	201	76	38
6	Reduce the number of print books purchased in case of e-books availability	31	26	258

Table 11 reveals that, 'cancel duplicate print subscriptions if electronic database is available and subscribe to only the electronic versions of new database titles' are agreed by 95% users, which is marginally followed by 'cancel lesser used print database' 94%, and place fewer new subscriptions to print database 80%. Financed additional electronic database by 'pay per use' (users pay per article accessed) is agreed by 64%. On the other hand 82% disagree to the statement "Reduce the number of books purchased". The analysis reveals that, electronic and digitised documents are more preferred by the users than print, although for reading purpose users choose the print form of document. Electronic database are easy to access for retrieving full text article within a short period. It saves the time of the users in locating their desired information.

4.12 Used of bioinformatics tools

According to Geer, analysis software programs, are now essential tools in biological and medical research, based on their demonstrated power, rapid growth, and wide spread use. Less well established are: a) an understanding of the range of user groups and their information needs, b) a knowledge of how well these users employ these resources, c) an identification of the organisational units in an institution that provide centralised bioinformatics educational and end-user support programs, and d. a specification of the roles medical and science libraries can play in facilitating access to and effective use of this vast array of bioinformatics resources.

Table 12. Bioinformatics tools used for research

No.	Rank	Bioinformatics Tools	No. of Response	No.	Rank	Bioinformatics Tools	No. of Response
1.	1	WHAT IF	300	23.	10	SEQUIN	189
2.	1	XmMol	300	24.	10	SRS7	189
3.	1	Ensemble	300	25.	10	THREADER	189
4.	2	GeneDoc	295	26.	10	Discovery Studio	189
5.	3	C Clustering Library	270	27.	11	Sybyl	185
6.	4	EMBOSS	250	28.	11	GLIMMER	185
7.	5	BLAST	230	29.	11	Epiplot	185
8.	6	RasMol	210	30.	11	TPRAS	185
9.	6	FASTA	210	31.	12	SSPS	181
10.	7	AutoDock	200	32.	12	PRAS	181
11.	7	DNA Strider	200	33.	12	InsightII	181
12.	8	ClustalW	195	34.	12	PSST	181
13.	8	VMD	195	35.	12	BSDD	181
14.	9	BioSap	192	36.	12	RP	181
15.	9	DNA STAR	192	37.	13	CAP	177
16.	9	Pathway analyst	192	38.	13	WAP	177
17.	9	AMPS	192	39.	13	SEM	177
18.	9	Primer 3	192	40.	13	3D-SS	177
19.	9	NAMOT	192	41.	13	PSAP	177
20.	9	PHYLIP	192	42.	13	RPMS	171
21.	10	MxCurv	189	43.	14	CSSP	171
22.	10	X-PLOR	189	44.	14	PROSA-II	171

Bioinformatics tools are one of the most important tools for bioinformatics users. Therefore users are asked regarding the bioinformatics tools use for their research with multiple choices of answers permitted as presented in table 12. The study reveals out of 315 users, 300 users choose WHAT IF, XmMol and Ensemble. Marginally followed by GeneDoc (295/315), C Clustering Library (270/315), EMBOSS (250/315), BLAST (230/315), RasMol and FASTA (210/315), AutoDock and DNA Strider (200/315). From the analysis we can conclude that research needs emerged as the driving force behind the use of bioinformatics tools. These needs determined which applications to use and were the major reason for conducting this research. Therefore the studied bioinformatics tools appear to be the appropriate applications for conducting bioinformatics research.

4.13 Areas of research perform by users

Users are asked about the area of research perform in the research laboratory. Various categories of research have been performed by users, but they are merged together and specified as with the broad subject areas as shown in table 13. The common research area performed is analysed as below.

Table 13. Areas of research performed by users

No.	Areas of research	No. of Response	Response in %
1	Computational genomics	300	95
2	Database &software development	300	95

3	Chemical &systems biology	270	86
4	Protein structure prediction	270	86
5	Gene analysis	250	79
6	Reproductive biology	210	67
7	Plant genomics	200	63
8	Gene function exploration	170	54
9	Genomics and molecular medicine	150	48
10	Drug design	110	35

The study illustrate that the maximum research area is perform in Computational Genomics and Database & Software Development each response to 95% users. Similarly, Protein Structure Prediction and Chemical & System Biology research is perform by 86% users each. Marginally followed by Gene Analysis (79%), Reproductive Biology (67%), Plant Genomes (63%), Gene Function Exploration (54%), Genomic and Molecular Medicine (48%) and Drug Design (35%) are the areas of research performed by the bioinformatics users. These research areas illustrate the changing roles of professionals in the new information-based basic research environment.

4.14 Users training and workshop

Knowledge gaps and extensive learning time engaged as key factors that in combination inhibited the use of bioinformatics tools. In particular, trainee felt that learning to analyse the results would require a substantial learning effort and time investment. Therefore alternative ways to analyse is to examine that training and workshop plays an important role for bioinformatics users.

As shown in table 14, the illustration of the study shows that out of 315 users, 250 user's mention that their centre conduct training and workshop programme and they (250 users) also attend the same programme for enhancing their research and self-up-date in various bioinformatics resources. Those who attend the training and workshop attend for month (43%), a week (39%) and a year (18%). Among the trainee, those who attend the training a year received stipend for their expenses.

Table 14. Users training and workshop profile

No.	Parameters	No. of Response	Response in %
1	Centre Conduct Training and Workshop	250	79
2	Attend the Training and Workshop	250	79
3	Enhance Research Work	250	79
4	Stipend Received	45	18
Duration of training			
1	Week	97	39
2	Month	108	43
3	Year	45	18

Those who attend the training and workshop are more informative and update with the latest trends in bioinformatics than those who do not attend the training and workshop. The majority of users find these training programmes useful in enhancing their skills as shown in table 9 assumption 3 too.

The areas of training and workshop attended by the users have been shown in table 15.

Table 15. Training and workshop attend by users

No.	Area of Training and Workshop	No. of Response	Response in %	Rank
1	Bioinformatics software and tools	250	100	1
2	Computer aided instruction, modelling and simulation	250	100	1
3	Handling and management of biological data, including its organisation, control, linkages, analysis and so forth	250	100	1
4	Search and retrieval of biological information, documents and literature	250	100	1
5	Bioinformatics and its emerging dimensions	250	100	1
6	Computational biology	240	96	2
7	Genome analysis, protein structure prediction and drug design	230	92	3
8	Routine sequence analysis	230	92	3

The maximum response (250/250) in the area of research the trainee attended are; bioinformatics software and tools, computer aided instruction, modelling and simulation, handling and management of biological data, including its organisation, control, linkages, analysis and so forth, search and retrieval of biological information, and Bioinformatics and its emerging dimensions, marginally followed by Computational Biology (96%), Genome analysis, protein structure prediction and drug design, and Routine sequence analysis (92% each). This finding reveals that the areas of taining found to useful for the users as most of them have attended these courses. Though the users are satisfied with the training programmes and areas of training cources, centres should organise some basic literacy programmes for accessing the online and offline bioinformatics resources like federated search, discovery tools, subject specific gateways which was pointed out by some users.

4.15 Problems faced in accessing bioinformatics resources

The data interpretation for problem faced in accessing bioinformatics services from various sources are presented in table 16 as shown below. The study shows that out of 315 users, 295 users do not have any problem, on the other hand 20 have problem in accessing bioinformatics services. When seeking information, the most frequent and major problems mentioned by the users are; not having enough time to search for and gather information, Article request through ILL consumed time, slow internet speed consume time in downloading files. Authentic information is too hard to find and not knowing or certain about what is available in online.

Table 16. Problems faced in accessing bioinformatics resources

No.	Problem Faced	YES	NO
1	Having Problem in Accessing Bioinformatics Resources	20	295
	Reasons for problem faced		
i.	Not having enough time to search for and gather information	5	-
ii.	Article request through ILL consume time	2	-
iii.	Slow internet speed & consume time in downloading files	3	-
iv.	Authentic information is too hard to find	5	-
v.	Not knowing/ certain about what is available in online	5	-

Therefore we can assume that discovery service is required by the users which can be provided by the librarian based on the library collections i.e. Print and Electronic media available in the library.

4.16 Level of satisfaction about library and BIC services

Question has been asked to the users regarding their level of satisfaction about the library and BIC services after accessing their required information. Based on the response received data interpretation is presented in table 17. The level of satisfaction shows that 260 users are satisfied in regards to the library resources and bioinformatics databases and tools. Similarly 265 users are satisfied after accessing the bioinformatics services from various sources. Out of 315 users 248 users are satisfied about the research laboratory available in the research centre.

Table 17. Level of satisfaction about library and BIC services

No.	Level of Satisfaction	Satisfied	Somewhat Satisfied	Unsatisfied
1	Library resources	260	35	20
2	Bioinformatics services from various sources	265	30	20
3	Accessing Bioinformatics Database and Tools	260	35	20
4	Research laboratory	248	47	20

The above table analysis shows that most of the users are satisfied about the library and BIC services. Hence we can assume that the services meet the users' information needs and requirements.

5. Conclusions

Researchers required immense sources of information inside and outside of their study zone. Yet this is no easy task, and would require more resources for processing and improvement of context based knowledge sources, to develop new research. The present ICT based environment has demanded new job requirements; new roles, adequate competence and different kinds of skills form the professionals which would help them to develop new product and services in response to new developments. Hence, there was strong interest for the library to become an active agent in providing bioinformatics consultation and training services for different levels of sophistication and skill. The types of library resources used by the bioinformatics researcher's vary from one researcher to another based on the information they required. Strong interest was expressed in additional services as shown in table 5, which is one hundred per cent of the bioinformatics users required increase holdings of laboratory manuals, handbooks, and other procedure references for updating their research. Libraries must maintain a well-rounded core collection development, including reference material to satisfy the information needs and uses of the bioinformatics users. These may be supplemented through networks, e-resources, library consortium, etc., to achieve better qualitative and quantitative standards. Library collections are dynamic resources therefore, constant renewal of materials/ collections to ensure that the collection remains relevant to the users is essential. In spite of the resources, and services some users express their problems, such as; authentic information is very hard to find and some laymen librarian cannot provide their required services and resources in the right time. Therefore, we can conclude that the less problem is faced in accessing and acquiring bioinformatics information and services from various sources the more satisfied is the users. Hence, the types and scope of bioinformatics services that can be provided by the bioinformatics library will greatly depend on the level of available subject specific expertise.

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