Paper II - Core

Paper Code:

Title of the Paper: User studies and Informetrics

Unit-I

User studies concept and Categories – Aims and objectives – Importance of user studies – Need for conducting user studies. Major user studies conducted in India (14L)

Unit – II

University and college library user behaviour – evolving a theory of user behaviour – Characteristics - patterns of user behaviour users and their influencing factors – Limitations in behavioural research in librarianship - User needs and user education: concepts – Aims and objectives – planning of user education – problems of user studies and user education. (11L)

Unit -III

Evolution of the concept of Infometrics -Librametrics, Bliometrics, Scientometrics - Theory and Laws - Zipf's law, Lotka's Law, Bradford's Law. Price Theory and Circulation theory. (12L)

Unit – IV

Quantitative and Qualitative techniques: Types, Multidimensional scaling, Cluster analysis, Correspondence analysis, Coword analysis and, media and audience analysis, SPSS.11.0 version (13L)

Unit –V

Citation Analysis; Definition, Theory of citing, different forms of citations, Age of citation – citation counts, Self -citation - Application of Quantitative and Qualitative tools and techniques in LIS Research (10L)

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USER STUDIES

UNIT 1

INTRODUCTION TO USER STUDIES

1.0. OBJECTIVES

To introduce the students of LIS to the basics of user studies, its scope, brief history, importance and the methodologies applicable to conduct these studies.

1.1. OUTCOME OF LEARNING

After reading this unit, you will be able to:

- understand the basics of user studies,
- enumerate the scope of user studies,
- account the brief history of user studies
- discuss the importance of user studies, and
- elaborate methodologies applicable to conduct these studies

1.2. STRUCTURE OF UNIT

- Introduction
- Scope of User Study
- Brief Historical Account
- Why User Studies?
- Research Methodology
- Summary
- References

1.3. INTRODUCTION

Libraries are established to provide services to their users. While planning library services, users have to be always kept in view so that the services being proposed and introduced are valued and used to the maximum extent. Most of the patrons are infrequent users who make a few demands for the service. If the library focuses on the heavy users and their known demands and needs, it can achieve outstanding performance… (Evans, et al.1972). However, the philosophy of librarianship is not only to serve heavy and regular users but also supposed to look after the interests of casual and infrequent users. Everyone whosoever visits the library or asks for information should find his/her information conveniently. Everybody in academics; a student or a teacher comes across some or other problem in finding and accessing information. You as students of Library & Information and also as users of the library and its services might be fully familiar with such day-to-day common problems faced in finding relevant information. To know as to what problems users face in locating and accessing information, a paper on User and User Studies' has been introduced in the LIS curriculum so that the students of today and information professionals of tomorrow are able to understand and conceptualize users‟ problems. Take a simple example of a shopkeeper, who thinks of his consumers before the opening of a shop and goes on adding items which have the possibility of their use and scalability. We notice shopping mall culture in all big cities, and small shops/stores in small cities and villages with different commodities to sell according to the requirements of the consumers. The same principle holds good in librarianship also with the difference that one earns a profit and another provides services without aiming at any profit. The profit is earned and measured in the form of user satisfaction with the services being provided. The primary concern of the library profession has been to assess the information needs of the users and assist them in finding their information resources to solve their day-to-day problems relating to information access and use.

Information has been recognized as an important resource and commodity for the overall development of individuals as well as nations. Today, the richness of nations is measured in terms of the availability and use of information. Information poverty or illiteracy is considered more dangerous than economic poverty. One of the differences between the developed and developing nations is that the former makes good use of information than the latter. If we believe that information and knowledge is a powerful resources, then their holders obviously become powerful. Therefore, the availability and use of information make the difference. The very purpose of information and knowledge generation is its use for the overall development of humanity and society. Right from the inception of libraries, serving the users to their utmost satisfaction has been the one and only objective. User study investigates the information requirements [of the users] almost entirely with how a user navigates a given system and what he or she could do with the data (rather than information) made available by information systems. … (Wilson, 2006). Information science firmly founded upon an understanding of information users in the context of their work or social life is also likely to be of more use to the information practitioners by pointing the way to practical innovations in information services, and to potentially beneficial association with other communication-information-related subsystems" (Wilson, 1981). Hollnagel (1980) also writes that information science is concerned with the use of information by humans … and it is concerned specifically with the way in which humans search for information, systematically as well as unsystematically. The basis for information science is therefore to be found in our experience of using and searching for information from the users.

The scope of user study is quite wide and diverse which includes all the aspects of users as well as non-users relating to the use of information. This has been an intriguing area of research in which behavioural aspects of human beings are to be studied which is ever-changing according to the situation and many other factors. Users are the consumers and library professionals are the producers, organizers and communicators of information and information products. Therefore, the library has to be constantly in touch with its consumers (users) as their behaviours and needs go on changing from time to time. We can easily identify the difference between the users of the 20th century and the present era. If a library is developed by isolating its present and future readership, it is likely to fail in its objectives. Therefore, it is important that the library is fully aware and acquainted with the needs and requirements of its community to be served. Taking the analogy of producers and consumers as cited above, it is important for the producers of the products to first make an assessment of the market as to what types and kinds of products are required in the market. The library should provide what its users want. After doing a proper survey of the market, products are manufactured based on consumers‟ needs and behaviour to yield maximum output in the form of use, salability, profit, etc. whatever the case may be. Similarly, library professionals also should adopt the same analogy to know and understand the customers‟ (users) need and take the necessary steps to meet them. The library should always aim to identify and develop services to the maximum satisfaction of users. If there is any disconnect between the two, all effects, money, etc, being spent are going to be a big waste. Given this, a user study is a prerequisite to providing need-based services and developing and modifying information systems and services from time to time.

1.4. SCOPE OF USER STUDY

User means information user, patron, or clientele of the library who seeks information from various sources available to him to remove his „uncertainty‟, „inquisitiveness' 'and ambiguities' to meet his/her information need and solve various problems at hand. In these studies, user and user groups remain in focus to know and ascertain the facts about their information needs, information use and information-seeking behaviours, etc. The scope of user study … can be expanded to include parts of computer science, communication studies and other disciplines (Wilson, 2008). Hewins (1990) called for increased interdisciplinary research in this area. She suggested that research in this area should integrate research being conducted in other disciplines (e.g., psychology, cognitive science and computer science). Wersing (1973) divides user studies into four areas: channels of communications, information receivers (users), data sources and information senders. The core of user studies has three main components; information needs, information-seeking behaviour and information retrieval, all studies revolve around these aspects. Let us broadly understand these two concepts since these are not precisely definable. We need information when we feel that our existing knowledge is deficient or inadequate to solve the problem at hand for study and research. In such a situation, users start searching for information from various sources known to them. How users process their information needs and retrieve and use information by going through different stages and steps. Krikelas (1983) states that „information-seeking begins when someone perceives that the current state of knowledge is less than the needed one to deal with some issue (or problem). These concepts would be discussed elsewhere in detail in different modules. Nicholas and Herman (2009) have devoted a whole chapter to defining these terms. These studies broadly include all interactions between users and their information products (sources of information), information-seeking behaviours including searching and retrieval processes, cognitive processes, barriers and intervening variables in information accessing and use (Chandel, 2011). Eithel (1981) states that user studies are composed of who reads what; and how these needs can be identified and satisfied. Tenopir (2003) identified the following areas of user studies: i) What do people do? ii) What do people prefer? iii) What do people say they do? iv) What do people say they prefer? v) What they may do or prefer in the future?

The author prefers the term people rather than user which means, involving the whole community to be studied to ascertain the information need of the whole population to be served rather than only library users. The needs of users and the needs of the people are different. Non-users are to be converted into users or educated to use information. Therefore, the identification of information

needs of diverse populations forming different groups of people in the community is required to be studied to serve them in a better way. Krikelas (1983) in his model identified four steps of information processing and use (1) perceiving a need, (2) the search itself, (3) finding the information, and (4) using the information, which results in either satisfaction or dissatisfaction.

The thrust areas of these studies can be summarized as under:

i) To study the reading interests and the preferences of the various categories and groups of library and information users belonging to different disciplines and environments.

ii) To know what are the roles, activities, job profiles, academic background and social life, etc. of the user groups and how these affect their information needs and information-seeking behaviours?

iii) To study the information-seeking behaviour of different categories of users, how they search for information and what search strategies, browsing patterns they follow, and what problems and barriers they face in the process of finding information?

iv) To know what are the theories and models established on information-seeking behaviours and needs, and how the identification of the behaviours are useful in such studies?

v) What channels of communication and sources do the users quite often consult and use and with what frequency?

vi) To evaluate the services being provided with users' perspectives and take their feedback to improve and make services more effective and meaningful.

vii) To go beyond what, why, and how of usability of resources and find out the measures to educate and direct them to use the right resources which may not be known to them through educating users.

viii) To study non-users to know why information available to them is not being used, and identify those factors which are responsible for the non-use or under-use of resources.

ix) To know the level of user satisfaction from the services being provided and take appropriate measures to improve them, etc. Wilson (1994) presented a model of user study covering the following components in his paper published as early as 1981 which has as much relevance today as during the time of its proposal.

We may agree that most "user studies" have been about how people use systems, rather than about the users themselves and other aspects of their information-seeking behaviour (Wilson, 1994). These studies include: who library patrons are, how they use libraries, and more recently, what the information needs of people are and how various sources of information help or do not help them, independently of formal information delivery systems such as libraries (Julian, 1996). Various literature surveys have also revealed that most of the studies have been conducted on sources of information being referred by the users. Now the question arises as to what follow-up actions are required to be taken by the practitioners in the light of such findings. In such a situation, when users were found to use e-resources more than printed material, their preferences were found more on Internet resources in full-text form than resources in the library in printed format. Given such findings what measures have to be taken as a follow-up action to improve the existing services by the practitioners need to be ascertained and thoughtfully implemented. The recommendations and findings of most of these studies have not been implemented. The outcome and implementation of user studies remain questionable even though a lot of literature has been generated on the subject. Nevertheless, the importance of these studies cannot be undermined, provided an appropriate research methodology is applied. Both users, as well as non-user groups, form the population of such studies to be conducted with a holistic approach relating to information communication, access, retrieval, transfer and exchange.

1.5. BRIEF HISTORICAL ACCOUNT

Libraries were never established isolating their users. They have always been there in the background of the establishment of any library. User studies have a long history; as long as the libraries themselves. Users have been always in focus right from the inception of libraries all over the world. Libraries cannot be thought of without their users. It is a different matter that the formal studies began much later when the need for such studies was realized and brought out at the verbal plane. Before the initiation of these studies, librarians used to assess users' need for books and other material hypothetically based upon their perception, formal or informal interaction with the users and indirectly observing their behaviours while in the libraries and using resources. Users‟ statistics might have been another indicator of users' approach to library collection usage and users' preferences in the beginning. Wilson (2008) traces its history from 1916 whereas he also quotes the study by McDiarmid (1940) on a library survey produced in 1940. Siatri (1999) states that the beginning user study started in the 1940‟s. Till 1965, there were 676 user studies listed in the „Bibliography on User Studies‟ (David and Bailey, 1969). More studies started coming up after 1948 when Royal Society Scientific Conference was held. The first library surveys were designed to discover what categories of persons used libraries, not what those persons did when they were in a library nor what life or work issues were behind their library use. In earlier studies emphasis was on the discovery and description of document usage (Wilson, 2008).

During the 1960‟s two important studies were conducted by Menzel (1966) and Line (1971) in the field of science and social science respectively which deserve special mention because of their landmark contributions to further studies. These two studies made an impact and the need to conduct such studies was well realized by the professionals. INFROSS study started in the autumn of 1967 with a large sample with multiple questionnaires, which led to the design of information systems in social sciences. This was the first study conducted in the field of social sciences whose objectives were achieved by implementing its findings. However, such studies had been attempted earlier in the field of science but not in the field of social science since there was more awareness and consciousness of the use of information among scientists as compared to social scientists. Menzel (1966) and Line (1971) made a good beginning for user studies and set directions for further studies. During 1963-1969 the American Psychological Association (APA) conducted a series of studies on users‟ behaviours. During the 1970s these studies became quite popular and many research projects were funded by various organizations and associations. In India, the feasibility study of the establishment of NISSAT (National Information System in Science and Technology) was conducted by Peter Lazar in 1970 assessing the information needs of the scientific community of India on behalf of UNESCO at the request of Govt. of India.

The establishment of the Centre for Research on User Studies (CRUS) in 1975 in the Department of Information Studies at the University of Sheffield gave more emphasis to conducting user studies (Siatri, 1999).in 1975 the Department of Information Studies at the University of Sheffield gave more emphasis on conducting user studies (Siatri, 1999). The Department had started user studies in the early 1970s as reported by Roberts and Wilson (1988). These studies were in the form of student dissertations and occasional research projects but got further promotion under the project funded by BLRDD (British Library R. & D. Department) (Wilson, 1995). Earlier studies were limited to library surveys relating to library use, readers' preferences and interests. Crawford (1978) estimated that there might have been more than1000 studies up to 1978. More and more literature started coming up during the 1980s and 1990s onwards, with a broader scope of these studies. During 1990 there were only 9 papers which had appeared on the Web of Science which increased to 200 by 2006 (Wilson, 2008). However, Web of Science does not cover all the journals of Library & Information Science. Therefore, some studies might have been not been covered in the web of science. From 1990-1994, 588 articles were indexed in library literature under the terms „use studies‟ and „information needs‟ (Julian. 1998). During the 1990s user studies became one of the main areas of research for PhD programmes in many universities in India and abroad. The courses on user studies were also introduced in many schools/Departments of Library & Information Science.

It is now estimated that 200-300 articles are being published every year on the subject (Chang, 2011). Jarvelin and Vakkari (1990) estimated that research on information needs and uses constitutes 8% of total research in Library and Information Science. However, according to Wilson (1981), the progress towards some theoretical understanding of the concept of „information need‟ has been slow, though literature growth was quite high. He supports his remarks by the statement that subjects from Menzel to Paisley through the various authors in ARIST volumes to Ford review of 1977 did not show any significant progress in theoretical understanding mainly due to inadequate methodology and failure to do cumulative research. On the other side, he also mentions elsewhere that there is no other area of information science except information retrieval that has occasioned as much research effort and writing as „user studies‟ (Wilson, 1981).

Literature growth in user studies has been fast from 1990 onwards but regretfully as had been realized by many authors and practitioners that the implementations of the findings of these studies have not been so significant. Despite the accumulation of vast literature including thousands of PhDs produced, there is hardly any theoretical foundation for these studies with generalized findings and conclusions, perhaps because of the lack of standard methodology and the nature of the subject which involves a behavioural pattern of users which are ever-changing from one situation to another. Nevertheless, there are some important contributions in the form of various models of information-seeking behaviour which will be discussed separately in other modules of this course.

1.6. WHY USER STUDIES?

One of the topics discussed during the International Conference of Scientific Information held in 1958 was 'Literature and reference needs of scientists…'. This conference provided a good platform to deliberate on the information needs of scientists. Urquhart (1948) made the following statement during the conference, highlighting the importance of user studies:

"…a knowledge of the requirements of the different users of scientific information and the uses to which they wish to put the information they secure should be the ultimate determining factor in the designing of methods of storage and retrieval of scientific information."

Evans, et al. (1972) stated that determining user requirements is most important as an aid in evaluating, selecting and weeding out needs which are not being met. According to Dewe & Deunette (1979) developers of information, services should see to it that information from users is more actively involved in the designing phase and that the environment within which the services are used in all their sociological and psychological are also taken into account.

Hood and Blackwell (1976) in their United States study identified that a significant meaningful pattern can be established [by conducting a user study], and there would be at least a beginning basis for designing and redesigning information products and services in terms of different classes of users. Planning any functional and effective information system requires the study of user behaviour, which of course is not as easy as it appears to be. John Martyn (1974) while endorsing the opinions of many others, agrees that the ultimate value of any information communication system should be thought of in terms of users, that is made of the information and subsequent impact of information on users' scientific and technical behaviour. Hale (1986) summarized the purpose of user studies to:

i) Optimizing the allocation of operating resources by customizing services to a selected clientele
ii) Fine-tuning the delivery of information within existing systems.

It is unanimously agreed that knowing your present and future leadership is of paramount importance and the prerequisite to designing and developing any information system to provide need-based information services, failing which there is every possibility of mismatch and disconnect between producers and the consumers. It becomes increasingly important when practitioners think of the marketing of information. This pre-supposes surveying the market (community) of users to assess the information needs of the consumers fully well so that information products and services get their clientele. Belkin (1977) also realized that information users are often in an anomalous state of knowledge (ASK) this anomaly can be resolved by "the effective communication of desired information between the human generator and human user." This state of knowledge is caused by „uncertainty and 'inadequacy of knowledge' prevailing in the minds of the users which needs to be resolved so that they can come out of the prevailing „problematic situation‟ and find the solution through getting information. This requires perfect communication between the generator of information and the recipients and thorough cognitive analysis of the queries existing in the minds of the users. Most of the users even remain unaware of some of the useful services being provided by the library and are not likely to make use of such services. This situation arises due to the lack of communication between the library and its users. Information science mainly deals with collection building, organizing and systematization, retrieval and use of information resources. A useful information output can only be created if the designer understands the product's intended users and their information needs (Landu, 1982). At every stage participation and involvement of users play an important role in introducing, improving and reinventing services.

In the survey report of DLF, the objectives of the user survey have been identified as under:

i) Patterns, frequency, ease, and success of the use

ii) User needs, expectations, perspectives, priorities, and preferences for library collections, services, and systems

iii) User satisfaction with vendor products, library collections, services, staff, and Web sites

iv) Service quality

v) Shifts in user attitude and opinion

vi) Relevance of collections or services to the curriculum (Covey, 2002).

1.7. RESEARCH METHODOLOGY

There is a unanimous opinion that studying library use and the user is one of the important areas of study which has been well realized since the 1960s. It is also true that research output has its value provided results are authentic and reliable so that the findings of these studies can yield desired results. Various literature surveys have revealed that there has been a large number of studies on the subject. The question arises about the reliability of the data collected and the authenticity of the findings drawn out from these studies. The common methodologies applied in these studies have been: observation keeping „… our eye on a user‟ (Zweizig, 1976), analysis of documentary sources, library usage through library statistics, case study, citation analysis, interview, etc. (Chandel, Saraf, 2002). With the advent of new technology, new research methodologies have evolved; such as data collection through E-mail, social networking, online interviews, virtual ethnography, log analysis, etc.

The application of a strong research methodology is necessary for every research topic irrespective of the area of research and discipline. These studies, it has been mostly a survey method based on scheduled questionnaires. The authenticity of data collection through the survey method has always been doubtful. It is a common observation that questionnaires are rarely filled up seriously and honestly by the respondents. When filled up and responded to, there are biased opinions. However, it depends upon the researcher as to how reliable data is to be collected and which methodology is to be applied. Crawford (1978) has rightly made the following observation:

'Sophisticated social science concepts combine with quantitative techniques produced both case report and field studies…utilizing well-designed survey instrument, carefully selected. Stratified random sampling, and appropriate techniques of statistical analysis… slowly, valid and empirical data are being accumulated which in time will contribute to a unifying theory of information needs and uses. These accumulated findings and data after scientific analysis lead directly or indirectly to the improvement of systems.'

The pertinent question before us is to know as to what these accumulated findings have given to the profession and how far these findings have been responsible to achieve the identified objectives. Most of these studies have been attempted only for sake of research, not for implementation and arriving at some theoretical foundations and models. Only a very few selected studies have made a significant contribution to the profession. It is the choice of the right sample and the right methodology that matter significantly in these studies (Chandel and Saraf, 2002). Julien et al. (2011) while analyzing methods used in studying information behaviour of users conducted from 1984 to 1998 reported that 58.1% of the studies were based upon the survey method. The declining trend of using the survey method from 58.1% to 44.7% was reported in another study conducted for the period 1998-2008 (Julien and Duggan, 2000). Applying the content analysis method to analyze literature published on LIS from 1990-1994 found that 56% of research methodologies employed in research studies were based upon survey research the "other" category of research methods included content analysis, and unobtrusive observation, and cluster analysis (Julien,1996). The analysis further revealed that log analysis, ethnography, interview, citation and experiments methods were also used.

The survey method based upon a questionnaire has its inherent limitations often criticized but hardly replicable. This means that the methodology must be used thoughtfully and carefully to collect factual data by applying a single methodology or in combination with another method (s). Lyons (2011) while pointing out the limitation of research methodologies being applied observed that "…often they employed deficient research methods or promote unjustifiable interpretations of data they have collected." Greifender (2011) observed that library and information science education does not always offer librarians in-depth methodological education in social science, psychology, ethnography, mathematics or computer science. But now teaching of research methods is being given due importance in almost all the teaching departments in Indian Universities at Master's Degree and PhD levels. Over the years, there has been good progress in the improvement of research methodology and synergies and combinations of methodologies are being applied for authenticity and reliability of data. Since user studies mostly deal with the behaviour and attitudes of users, so complexity and intricacies in attempting these studies are quite obvious and can be solved by the combination of qualitative and quantitative methodologies.

1.8. SUMMARY

The history of „user studies" is now more than 70 years old and large numbers of research papers, PhD theses, dissertations, project reports, and conference and seminar presentations have been cumulated. During the 1970s and 1980s trend was to write on classification indexing and information retrieval. It was also realized that the studies of users' behaviour and identification of their need for information are prerequisites to planning and developing information systems, improving existing services and evaluating the functioning of the library from users' perspectives. Given this, user studies represented an increasing proportion of information science research (Summers, 1984). Wilson (198l) made this observation at the beginning of the 1980s that "apart from information retrieval there is virtually no other area of information science that has occasioned as much research effort and writing as user studies." This trend continued during the 1990s. Even today many studies are being conducted on the subject but with different approaches warranted by the new environment of the digital age. Traditional settings of users have changed in the present environment. Users" behaviours over the years have been changing, consequently, the findings of these studies also lose their relevance with the changing attitudes of users. Their dependence on libraries has tremendously gone down and they are satisfied with whatever, they get on the Internet which calls for the conversion of print resources into digital which is easily available and accessible to them. Libraries have to meet such challenges to attract users to use their resources within the library or outside by modifying and reinventing services according to their preferences and choices. Ranganathan (1953) in his Five Laws of Library Science has focused on uniting the users with their resources with the purpose to maximize their use and serving them to their utmost satisfaction. Menzel (1964) also in his study on „Information Needs of Current Scientific Research.' emphasized the usefulness of these studies by stating that the guiding slogans must be speed, efficiency, and comprehensiveness [in the services being offered]. The overriding aim, in other words, is to bring information to the scientist promptly, to bring him all that is relevant, and to bring it to him with a minimum of waste motion, especially on the scientist's part. We should not depend upon our experience, judgments and presumptions about users' information needs, better ask them what they would like to read and for what purpose. This will enable libraries to serve them better.

1.9. MCQ QUESTIONS

1. The Theory of Ask (Anomalous State of Knowledge) was given by: A. Herbert Menzel B. T D Wilson C. C. Nicholas J Belkin D. James Krikelas

2. "Information seeking begins when someone perceives that the current state of knowledge is less than the needed one to deal with some issue (or problem)" is stated by: A. Herbert Menzel B. Tenopir C. Nicholas J Belkin D. James Krikelas

3. ‘CRUS’ stands for A. Centre for Research on User Studies. B. Centre for Research on the United States. C. Computer Research in the United States. D. None of the above.

4. Wersing (1973) divides user studies into ___________ areas.

5. During 1963-1969 __________ conducted a series of studies on users’ behaviours. A. The Modern Language Association (MLA) B. The Chicago style C. The American Psychological Association (APA) D. None of the above.

6. The core of user studies has three main components; information needs, information seeking behavior and _______ A. information overload B. information demand C. information retrieval.

7. Information seeking begins when someone perceives that the ________ is less than the needed one to deal with some issue. A. current state of knowledge B. quality of knowledge C. quantity of knowledge D. diffusion of knowledge

8. INFROSS study started in the autumn of 1967 with a large sample with multiple questionnaires, which led to the design of information systems in social sciences. True/False

9. The establishment of the Centre for Research on User Studies (CRUS) in 1995 in the Department of Information Studies at the University of Sheffield gave more emphasis on conducting user studies. True/False

10. The history of ‘user studies’ is now more than 170 years old. True/False

11. How many Ph D. were awarded by the Indian universities between 1950 -2012 on the topic 'Use and User Studies? _______________

12. User study is concerned with: A. Use of information resources B. User’s evaluation C. Users’ need and behavior D. All of the above.

13. The selection of available documents A. (both published and unpublished) B. (published)C. (unpublished) D. None of the above

14. Review of literature may be carried out from _____ A. books. B. periodicals C. research articles from journals. D. All the above.

15. ‘A literature review uses as its database reports of primary or original scholarship and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases, reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. Second, a literature review seeks to describe, summarise, evaluate, clarify and/or integrate the content of primary reports.’ This definition is given by A. Cooper B. Hart, and Chris C. Bruce. D. All the above.

16. ‘The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background and justification for the research undertaken (Bruce 1994). Bruce, who has published widely on the topic of literature review, has identified six elements of a literature review. These elements comprise a list; a search; a survey; a vehicle for learning; a research facilitator; and a report.’ This definition is given by -A. Cooper B. Hart, Chris C. Bruce. D. All the above.

17. Library Literature & Information Science (LLIS) is A. Full-text bibliographic database B. Library C. Society D. None of them.

18. What is LISTAA. Library, Information Science & Technology Abstracts B. Library and Information Service & Technology Abstracts C. Library Information System of Technical Advances. D. None of them.

19. What is LISA A. Library and Information Science Abstracts B. Library and Information Services in South Asia.C. Library Information System for Advancement. D. None of them.

20. Library and Information Science Abstracts is an international ___________ tool. A. Catalogue B. a department C. abstracting and indexing. D. None of them.

1.10. SHORT QUESTIONS

What is a user warrant?

What do you understand by User Study?

Why User Study is needed?

Write three limitations of a user study.

1.11. LONG QUESTIONS

Mention the different categories of users with examples.

Indicate the different steps in conducting a user study.

What are the different types of user studies?

KEYWORDS: User study; Methodology

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UNIT 2
EVOLUTION OF USER STUDIES

2.0. OBJECTIVES

- Evolution of user studies
- User studies in the 1930s, 1940's, 1950s, 1960's, 1970's, 1980's, 1990's, 2000's,
- User studies in India

2.1. OUTCOME OF LEARNING

After reading this unit, you will gain to:

- To know the categories of Library Users
- To know the Origin and Development of User Studies
- To know Different methods of User Studies
- To know Recent Trends in User Studies

2.2. STRUCTURE OF UNIT

- Introduction
- User Studies in the 1930s
- User Studies in the 1940s
- User studies in the 1950s
- User studies in the 1960s
- User studies in the 1970s
- User Studies in the1980s
- User Studies in the 1990s
- User Studies in the 2000s
- Some Important Library User studies
- Recommendations and Suggestions
- Summary
- References

2.3. INTRODUCTION

User studies, use studies, information-need studies, information transfer studies, communication behaviour studies, information dissemination and utilization studies, user research, etc., are all closely related and often not clearly defined and there is no universal definition. There is a need to understand the information need, and information-seeking behaviour of the user to facilitate library and information centres to provide effective and quality services to their users. It becomes necessary to point out the limitations of use and user studies. Use studies may not reveal the effects of use, indirect use of a library and information centres and many fruitful interactions of users with the library. Further, the use of a library and information centre and their utility to users are often quite different. A library or information centre may be used but it may not be useful; another may be useful but may not be used; a third may be neither useful nor used and an ideal is both used and useful.

2.4. EVOLUTION OF USER STUDIES

User Studies are one of the most important and most researched areas in library and information science. Earlier user studies were mainly related to scientists involved with biochemistry, medicine, engineering, physics etc. The high concentration of user studies in these sciences can be partially attributed to the fact that the publication of professional and scientific information in these disciplines was much more developed at the time in comparison with the humanities Technology, health, industry, and agriculture. It may be worth noting here that Dr S.R. Ranganathan has grouped users based on the types of services enunciated by him into the freshman, ordinary inquirer, specialist inquirer, and general reader.

2.4.1. User studies in 1930's

In the literature of LIS, the earliest reference we come across is to the study conducted by L.R. Wilson in the late 1930s. It was an attempt to investigate the distribution and status of libraries in the USA and was not aimed at obtaining information relating to library use or users.

2.4.2. User studies in 1940's

The foundation for the user studies was laid down in 1948 at the Scientific Information Conference of the Royal Society, where Urquhart and Bernal brought out their research findings. Urquhart (1948) conducted his study on the distribution and use of scientific and technical information. He was associated with the sources of reference to the literature borrowed, the purpose of consulting the borrowed item, and the usefulness of the item about factors like a year of publication and its form.

2.4.3. User studies in the 1950's

The concept of users and their information needs found some expression at the first conference of the Royal Society held in London and became a subject of discussion at the International Conference on Scientific Information held in Washington in 1958: Prof. J.D. Bernal's paper entitled `The Transmission of Scientific Information: a user's analysis" received great attention.

It may be mentioned here that a pilot study on the use of scientific literature by scientists was conducted by R.R. Shaw in 1956 on behalf of the National Science Foundation. Shaw's study is considered one of the pioneering efforts in the direction of user studies.

2.4.4. User studies in the 1960's

Literature review shows that the number of user studies increased rapidly. In 1963 the American Psychological Association (APA) conducted a series of studies concerning psychologists, which was one of the first and most important projects carried out in social and behavioural sciences (APA 1963– 1969).

Menzel refers first (Annual Review of Information Science and Technology, 1966) two comprehensive bibliographies of User Studies in 1964 and 1964, each containing 438 and 676 studies respectively.

Numbers of comprehensive studies have emerged on the subject: Use of Scientific Literature example, Davis and Bail compiled a bibliography consisting of 438 such studies as early as 1964.

2.4.5. User studies in the 1970's

Moving towards the 1970s, user studies flourished and introduced a diversity of target user groups like magistrates, urban citizens, personnel working in local authorities, university students, etc. The 1970s also mark the point that user studies examined the use of particular information systems, their efficiency and effectiveness and how this can be maximized. More scientists began to realise deficiencies in the use of methodological techniques and conceptualization although no theoretical framework had been developed. The trends of user studies during this period were well documented in the three chapters of ARIST on information needs and uses (Crane 1971; Martyn 1974; Crawford 1978).

It has been recorded that by 1977, more than 1000 important studies were conducted on the subject of `user studies. It must be mentioned that the growth of science and technology and, the importance accorded to the use of scientific information proliferated such attempts of user studies.

An event of great significance in the history of user studies was the establishment of the Centre for Research on User Studies (CRUS) in 1975 by The British Library at the University of Sheffield. The main objective of this centre was to create a national centre to act as a focus for research in user studies. Let us hope that researchers on different facets of `user studies' will receive encouragement from the centre in future and a theory of user studies would be developed. The establishment of a centre for research on user studies indicates the importance of the subject's user studies.

Martin (1976) in his article "User Studies and Library Planning" discussed user studies and appraised their role in library planning. The author provided various guidelines for conducting user studies and concluded that user data strengthen the planning and decision-making processes at several levels, so the responses of users should be an integral part of the ongoing practice of librarians, providing constant feedback.

2.4.6. User studies in the 1980's

The 1980s were a decade that was characterized by an increasing awareness surrounding the conceptual Framework and methodological issues of user studies. One of the first attempts at articulating this awareness was the publication, in the journal Social Science Information Studies of the papers presented in a symposium on qualitative approaches to the study of information problems.

Belkin (1980) formulated the theory of the Anomalous State of Knowledge for information-seeking behaviour that included six stages: starting, chaining, browsing, differentiating, monitoring and extracting.

Kuhlthau (1988) conducted a study examining the application of library skills in assigned library research by high school seniors. The objectives of the project were "to explore the experience of students in the library search process, to reveal evidence supporting the hypothesis that there is a sequence of stages to an information search and to propose a model of the user's stage within the search process" (Kuhlthau 1988: 232).

2.4.7. User studies in the 1990's

In the 1990s Internet becomes an information provider to the information community. The 1990's witnessed the implementation of conceptual theories that were developed during the 1980s and several researchers adopted conceptual theories and frameworks in designing their research design with qualitative research methods.

Several studies have been conducted to know the impact of the Internet on the user and information community.

In the year 1993 Tillman et.al conducted a study on the use of the internet as a reference tool by special librarians.

In the year 1996, another small case study was conducted by Eager and Oppenheim, to examine the information needs of academics. The major objective of this study was to know and test an alternative observation technique (shadowing). In this technique participant, 's would be observed the whole day.

Another study was conducted and published by Abel et.al 1996; Liebscher et al,1997) to explore the factors that influence the use and option of electronic networks by engineering and science faculties in small industries.

Eager and Oppenheim (1996) undertook a small case study examining the information needs of academics. The main purpose of the study was to test an alternative observation technique (shadowing), in which the participants would be observed throughout the day. A recent study (Abels et al. 1996; Liebscher et al.1997) was published examining the factors that

Influence the use and adoption of electronic networks by science and engineering faculty at small institutions. The study identified several factors that are likely to influence the use and adoption of electronic networks. These included perceived accessibility, proximity, workstation availability, and experience, ease of use, academic discipline, task and perceived utility.

2.4.8. User studies in 2000's

Wildemuth (2003) an article titled “Why Conduct User Studies? The Role of Empirical Evidence in Improving the Practice of Librarianship” emphasized that gathering evidence about library users, their interactions with library services and materials and the context in which those materials and services are used, librarians can make sound decisions for the future.

Carr (2006) “What Users Want: An Academic ‘Hybrid’ Library Perspective”. The author described the development of a user-centred approach in academic libraries over the recent decades.

Varghese (2008) “User Studies in the Electronic Environment: Review and Brief Analysis”. The article summarized the results of 101 user studies conducted in the electronic environment.

2.5. 10 SOME IMPORTANT LIBRARY USER STUDIES

Several library user studies have been made by various organizations in various countries, some important library user studies and their findings are described below:-

2.5.1. Council on Library and Information Resources (CLIR) and the Digital Library Federation, Dimensions and use of the Scholarly Information Environment

- Number of Interviews- 3,200
- 55.4% of all respondents browsed library book stacks to get information
- 52 % of graduate students use print resources
- 59% of graduate students use print indexes and abstract
- 11% use of e-journals
- 28% of users find reading materials on a screen satisfactory
- 14% want more print as compared to 11% e-Journals, 89% want more books

2.5.2. OCLC White Paper on Information Habits of College Students (June 2002) with a sample of 1050 qualified respondents:

Among its findings are these:

- 31 % of all respondents use Internet Search Engines to find the answer to their questions
- 89 % use the campus library’s print resources including, books, journals, articles, and encyclopedias
- Americans have not yet found ideal information resources

2.5.3. 10.3 Electronic Publishing Initiative at Columbia (EPIC) survey of responses from 1,233 students and scholars (2004)

Some important findings are:

- Dependent on physical library 75.8%
- To retrieve books and articles from the library’s website 81.5%

- Physical library use more than once a month 67.7%
- Search engines were not precise 80.2%
- The physical Library is still an important destination for students
- More than half of the respondents somewhat strongly agree that electronic resources can result in an overload of information…. And almost half of the respondents agree that this overload can be overwhelming for them.

2.. USER STUDIES IN INDIA

INSDOC conducted a user survey relating to its current awareness service entitled "INSDOC List of Current Scientific literature" as early as 1964. As a result of the findings of this survey, INSDOC had to wind up the above-mentioned current awareness service' and had to start the compilation of `Indian Science Abstracts.

Another significant study is conducted by Carl M. White regarding the use of the Delhi University Library in 1965.

In the same year (i.e. 1965) the Indian Association of Special Libraries and Information Centres (IASLIC) organized a seminar on "Users and Library and Information Service. Though the seminar did not discuss or, report any worthwhile study/survey, it helped in drawing the attention of the authorities of special libraries and information centres towards these problems.

Another significant effort was made by M.S. Sridhar. His doctoral research work was on Information seeking behaviour (ISB) of the Indian Space Technologists (IST) of ISRO Satellite Centre (ISAC), Bangalore. The results of this study have been published under the title "Information Behaviour of Scientists and Engineers". This study is a contribution to user studies.

2.7. RECOMMENDATIONS AND SUGGESTIONS

In changing environment of information overload, digital environment, fast-growing information users; and changing information-seeking behaviour of users, there is a need to conduct a user study to know the user's behaviour towards information. A user study shows the following facts which may facilitate to improve of library and information services to its users:-

- Information awareness of the users
- Interaction of user to library and information resources
- Information literacy skills of the information users
- Information use patterns of the library and information centres
- Information-seeking behaviour of the users
- The information needed by the users
- Information priorities of the users
- Evaluation of information users and information centres

2.8. SUMMARY

The user is an important component of the library and information centre. In the present Information Socie, ty it has been universally accepted that "Information is for use or Information for all." The right information helps users to solve problems, decisions making, do policy-making and prepare research projects.

There is a need to develop a healthy relationship between users and library & information centres. Now it becomes necessary to conduct user studies by the library and information centres to know facts about the library and information centre users. A healthy relationship between a library or information centre and users facilitates more information use and helps in the evaluation of library or information centres as well as users' behaviour.

While using e-resources users experience problems with search engines, overload of information and user wants to prefer physical library use. There is a need to conduct user studies to know users' problems, especially in a fast-growing digital environment.

2.9. MCQ QUESTIONS

1. The term Special inquirer said by A. M.S. Sridhar B. Carl M White C. T D Wilson D. S R Ranganathan

2. First user study was appeared in ______________

3. Pilot study on the use of scientific literature by scientists was conducted by A. R R Shaw B. J D Bernel C. Menzel D. OCLC

4. A Systematic User Study shows A. Information priorities of library staff B. Information priorities of the librarian C. Information priorities of the user D. Information awareness of the library staff

5. 1980's user studies were focused on A. users methodological issues B. qualitative approaches C. Information awareness D. All of these

6. Who formulated the Anomalous State of Knowledge for information-seeking behavior? A. Belkin B. Kuhlathau C. Menzel D. T D Wilson

7. Anomalous State Knowledge for information-seeking behavior includes Six Stages

8. Centre for Research on User Studies was established in the year. 1955 B. 1965 C. 1975 D. 1985

9. The 1990's user studies were focused on. Impact of the Internet on library staff B. Impact of Internet on library collection C. Impact of the Internet on users D. Impact of the Internet on librarian

10. The user study "Dimensions and use of the Scholarly Information Environment" conducted by A. Eager and Oppenheim B. OCLC C. EPIC D. CLIR

11. ProQuest Library Science provides full-text access to over ___________in library and information science

12. How many Ph D. were awarded by the Indian universities between 1950 -2012 on the topic 'Use and User Studies? _____________

13. User study is concerned with: A. Use of information resources B. User's evaluation C. Users' need and behavior D. All of the above.

14. The selection of available documents "____________" on the topic, which contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents in relation to the research being proposed.' A. both published and unpublished B. published C. Unpublished D. None of the above

15. Review of literature may be carried out from __________ A. periodicals B. books. C. research articles from journals. D. All the above.

16. 'The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background and justification for the research undertaken (Bruce 1994). Bruce, who has published widely on the topic of literature review, has identified six elements of a literature review. These elements comprise a list; a search; a survey; a vehicle for learning; a research facilitator; and a report.' This definition is given by -A. Cooper B. Hart, Chris C. Bruce. D. All the above.

17. Library Literature & Information Science (LLIS) is a -A. Full-text bibliographic database B. Library C. Society D. None of them.

18. What is LISTA A. Library, Information Science & Technology Abstracts B. Library and Information Service & Technology Abstracts C. Library Information System of Technical Advances D. None of them.

19. What is LISA A. Library and Information Science Abstracts B. Library and Information Services in South Asia. C. Library Information System for Advancement. D. None of them.

20. Library and Information Science Abstracts is an international __________ tool. A. Catalogue B. a department C. abstracting and indexing. D. None of them.

2.10. SHORT QUESTIONS

What was the title and year of the user study conducted by INSDOC?

What were the focal points of the 1980,s User Study?

What do you mean by information seeking behaviour?

What are library users called?

2.11. LONG QUESTIONS

What were the objectives of the study of Eager and Oppenheim (1996)?

What are the major findings of the OCLC White Paper on Information Habits of College Students?

What is the characteristic of information seeking?

KEYWORDS: INSDOC; Information seeking behaviour; Library users

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UNIT 3

REVIEW OF LITERATURE

3.0. OBJECTIVES

- Library and the review of literature
- Need for literature review on a user study
- International Users Studies
- Some selected database

3.1. OUTCOME OF LEARNING

After reading this unit, you will be learned to:

To understand the concept of Review of Literature on user studies

3.2. STRUCTURE OF UNIT

- Introduction
- Library and the review of literature
- How to write a review of literature on user studies?
- Need for literature review on a user study
- International Users Studies
- Some selected database
- Summary

  References

3.3. INTRODUCTION

The user studies in terms of library and information science have considered the studies related to library use. The library is used by the readers and library professionals having different objectives. The library professionals are information providers and readers are considered information recipients. These two aspects create a multidimensional platform regarding the use of library material available in various forms in various types of libraries. The users of the libraries may be different in their needs or expectations of the library.

Keeping in mind to provide better or improved services or desired information, the studies are being made by individuals or institutions from time to time. The objectives of these studies are to evaluate library resources for maximum utilization by the readers. The user studies in this discipline are also carried out to satisfy users in seeking information from the library regarding satisfying the five laws of library science.

In India, there are several studies conducted at schools, colleges, universities, academic institutions, rural libraries, and urban libraries to evaluate the information resources and readers' satisfaction with the library services and existing library resources. Before exploring the status of users' studies we have to explain the meaning of a review of the literature.

The 'Literature' covers everything relevant that is written in books, journal articles, newspaper articles, historical records, government reports, theses and dissertations, etc. on certain relevant topics. The important word is 'relevant'. However, the review of literature is a description of the literature relevant to a particular field or topic or disciplines or subject. While writing the review of literature, the main purpose is to convey to the reader what knowledge and ideas have been established on a study or topic, and to know the strengths and weaknesses of that study. A critical literature review is a critical assessment of the relevant literature. It is unlikely that you will be able to write a truly critical assessment of the literature until you have a good grasp of the subject, usually at some point near the end of your thesis.

In other words, it can be stated that a literature review is an account of what has been published on a topic by accredited scholars and researchers. Generally, it is being experienced in the introduction to an essay, research report, or thesis. It is not just a descriptive list of the material available or a set of summaries.

Besides enlarging your knowledge about the topic, writing a literature review lets you gain and demonstrate skills in two areas –

- **Information seeking:** the ability to scan the literature efficiently, using manual or computerized methods, to identify a set of useful articles and books.
- **Critical appraisal:** the ability to apply principles of analysis to identify unbiased and valid studies.

The review of literature is a subject of discussion and it is defined by various scholars. Some of the selected definitions are as follows –

'A literature review uses as its database reports of primary or original scholarship and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases, reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological. Second, a literature review seeks to describe, summarise, evaluate, clarify and/or integrate the content of primary reports.' - **Cooper: (1988)**

'The selection of available documents (both published and unpublished) on the topic, which contains information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents about the research being proposed.' **- Hart, Chris : (2005)**

'In writing the literature review, the purpose is to convey to the reader what knowledge and ideas have been established on a topic, and what their strengths and weaknesses are. The literature review must be defined by a guiding concept (e.g. your research objective, the problem or issue you are discussing or your argumentative thesis). It is not just a descriptive list of the material available or a set of summaries."

The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background to and justification for the research undertaken (Bruce 1994). Bruce, who has published widely on the topic of literature review, has identified six elements of a literature review. These elements comprise a list; a search; a survey; a vehicle for learning; a research facilitator; and a report. - **Bruce: (1994)**

A literature review is an evaluative report of information found in the literature related to a selected area of study. The review should describe, summarize, evaluate and clarify the relevant literature. It should give a theoretical base for the research and help the author determine the nature of the research. Irrelevant works should be discarded and those which are peripheral should be looked at critically. In another word a literature review is more than the search for information and goes beyond being a descriptive annotated bibliography. All works included in the review must be read, evaluated and analysed (e.g. Annotated bibliography), but relationships between the literature must also be identified and articulated, in your field of research.

3.4. LIBRARY AND THE REVIEW OF LITERATURE

The library is a rich source of knowledge and plays a significant role in providing relevant literature for literature review. The studies carried out on users of the library may have in the form of books, journal articles, working papers, monographs, theses, grey literature etc. These studies may be published or unpublished but certainly, find a place in the library. A good literature review requires knowledge of the use of indexes and abstracts, the ability to conduct exhaustive bibliographic searches, the ability to organise the collected data meaningfully, describe, critique and relate each source to the subject of the inquiry, and present the organised review logically, and last, but by no means least, to correctly cite all sources mentioned (Afolabi: 1992). The library offers a range of services and training for research scholars to assist with the production of literature reviews including sessions on electronic databases, using the bibliographic management software, End-Note to download records, Internet searching using Netscape, Library catalogue searching, off-campus student orientation, subject resources, and research skills.

The literature search is an important task when writing a literature review on user studies. Find out what has been written on user studies is available in the library or not. Use as many bibliographical sources as you can to find relevant titles. The following are likely sources: catalogues, bibliographies and references in key textbooks and recent journal articles, abstracting databases, such as LISA, etc. Citation databases, many abstracting journals and electronic databases are available through the University Library's Research Gateway. Today some e-resources are also available in the form of e-books and e-journals like Jstor, and doaj (http://doaj.org). These sources may be priced or freely accessible.

3.5. HOW TO WRITE A REVIEW OF LITERATURE ON USER STUDIES?

In general readers of the library are treated as the users of the library. While making a review of literature on user study we have to face a large number of studies on the relevant topic. These topics may be information-seeking behaviour, evaluation of library services, users' satisfaction towards library facilities and current awareness services, users' views regarding providing qualitative services etc. These studies may be different by their geographical area or by the nature of the study. Such kinds of studies may be conducted at the school, college, or university level. The studies can also be made for academic research or any other kind of special library. The setup of each library is different in its working and objectives. This indicates that a user study is a multidimensional problem which needs to be read and studied carefully. There are several steps in developing a literature review on user studies. These include:

Selecting the topic of user study for which review of the literature to be carried out like information seeking pattern of users in a particular library.

- Setting the topic in the context
- Looking at information sources
- Using information sources
- Getting the information
- Organising information (information management)
- Positioning the literature review
- Writing the literature review

Noting the bibliographical details is another task for literature review. For this, write down the full bibliographical details of each book or article as soon as you find a reference to it. This will save you an enormous amount of time later on.

Another important point in the literature review is finding the literature. Once you have what looks like a list of relevant texts, you have to find them. For this, use the library catalogues to see if the books and journals are held. For e-journals, look at the A-Z listing. For books and journals, you can use the catalogues available in the library. For journals, use the libraries or catalogue to see which libraries hold the journals you are looking for. If the book or journal you want is not held in the library, you may be able to access it through inter-library loans. The full text of many journal articles can be found on relevant electronic databases.

Now the further important point is reading the literature on a user study. Before you begin to read a book or article, make sure you wrote down the full details. Take notes as you read the literature. You are reading to find out how each piece of writing approaches the subject of your research/study, what it has to say about it, and how it relates to your study. Usually, you won’t have to read the whole text from the first to the last page. Learn to use efficient scanning and skimming reading techniques.

The last task is writing the review on the user study. Having gathered the relevant details about the literature on a user study, you now need to write the review. The kind of review you write, and the amount of detail, will depend on the level of your studies. You must be keeping in mind that a literature review is different from an annotated bibliography. An annotated bibliography deals with each text, in turn, describing and evaluating the text, using one paragraph for each text. In contrast, a literature review synthesises many texts in one paragraph. Each paragraph (or section if it is a long thesis) of the literature review should classify and evaluate the themes of the texts that are relevant to your thesis; each paragraph or section of your review should deal with a different aspect of the literature. Like all academic writing, a literature review must have an introduction, body, and conclusion.

3.6. NEED FOR LITERATURE REVIEW ON USER STUDY

A crucial element of all research studies is the review of relevant literature. According to Bourner (1996), there are good reasons for spending time and effort on a review of the literature before embarking on a research study in a certain field. These reasons include:

- To identify the gaps available in the literature of user study.
- To avoid reinventing and to build on the platform of existing knowledge and ideas related to user study.

- To create a research network regarding strengthening the knowledge of the subject area on a user study.
- To identify the seminal works on user study in your area.
- To identify information and ideas that may be relevant to your study.
- To identify methods that could be relevant to your study.

The user study is not now a new concept in India but the whole world. A large number of studies conducted in India so far. They are in the form of published and unpublished. The following are some selected relevant categories for review in users' studies.

The research activities are carried out in India by University Grant Commission or any other prominent educational and research institutions. The Ph.D. and M. Phil degrees are also conducted by universities or colleges in each discipline for the promotion of research in particular fields. To avoid research duplication in the relevant topic they follow the procedure of review for existing literature. There are provisions for theses to have research output of existing literature of Ph.D. degrees. These are available for further research and interest in their institutions. Some of the theses are also available in India at INFLIBNET and Other ETDs and Repositories at MG University Theses (Nitya), ETD@IISc, Vidyanidhi, Dyuthi@CUSAT, ETDs@Pondicherry University.

The reviews of the literature on users' studies are also available in journal articles and conference proceedings and seminar volumes. There are certain agencies like the Indian Library Association, IASLIC and other library institutions and organizations that produce literature on users' studies. For example 49th All India Conference was held at Bundelkhand University, Jhansi and published a book consisting of 68 articles in 623 pages covering various topics, such as user perception and need, user survey and feedback methods, ways to promote library services for users, innovative services to users.

Some of the studies are available in the form of working papers, monographs and reports of funded projects. A large number of studies were conducted in India on users' by using different aspects of the subject like information-seeking behaviour, use of resources and e-resources for certain kinds of libraries. Some of the known studies are as under:

Wilson has made a study on information-seeking behaviour in 1999, and 2000 which explores the identification of user's own needs for information, searching for such information in any way, and using or transferring that information. Wilson, T.D. has made a study on user studies and information needs. He is of the view that apart from information retrieval there is virtually no other area of information science that has occasioned as much research effort and writing as 'user studies'. Within user studies the investigation of 'information needs' has been the subject of much debate and no little confusion. Wilson has also attempted to reduce this confusion by devoting attention to the definition of some concepts and by proposing the basis for a theory of the motivations for information-seeking behaviour.

Information-seeking behaviour in libraries has been the focus of enquiry for students, researchers, teachers and professionals over the decades. Kakai, et al., (2004) have defined information-seeking behaviour as an individual's way and manner of gathering and sourcing information for personal use, knowledge updating, and development.

Initially, users' studies were conducted primarily to evaluate the collections of libraries and satisfaction with library resources and personnel as well. The studies concerned with information resources, and habits of individuals or groups lead to the design of appropriate information systems and services.

The focus of users' studies shifted to new approaches to information-seeking behaviour based on the technology. Line (2000), made new studies of information users and their needs even more necessary in the age of the Internet.

Mahajan and Preeti (2009) have also made a study on Information-Seeking Behavior at Panjab University of India by using primary data with a questionnaire from 250 users. The users were undergraduates, postgraduate students, and researchers in sciences, social sciences, and humanities disciplines. The study examined the kinds of academic information as per their need, which information resources they prefer, whether they are satisfied with the library collections, and the general pattern of information-seeking, with special reference to the influence of the course of study.

Golnessa Galyani Moghaddam and V.G. Talawar, (2008) have made a study on Interlending & Document Supply. The case study was conducted at the Indian Institute of Science for the use of scholarly electronic journals. The purpose of the study was to investigate the use of scholarly electronic journals at the Indian Institute of Science. A random sample of the main cohort was selected and, for five months from January 2004 until May 2004, 700 copies of the questionnaire were distributed among 40 departments of IISc; 397 completed and valid questionnaires (56.7 per cent) were received. The interesting fact was that people were interested in free access to electronic journals and preferred pdf format.

A study entitled "Electronic Journals' Usage and User Studies: a Literature Review" was published in SRELS (Sarada Ranganathan Endowment for Library Science) Journal of Information Management vol 47(2), 2010. There are many studies reviewed on user's study and published in different forms by several authors. It is very difficult to cite all the studies. Therefore, we have taken only some limited studies as an example to adopt the procedure for review.

Professor Shashi Prabha Singh illustrated the Doctoral Research Trends in Library and Information Science in India that approximately 119 Ph D. awarded by the Indian universities between 1950 -2012 on the topic 'Use and User Studies.

3.7. INTERNATIONAL USER STUDIES

Carol Tenopir has made a study on users entitled "Use and Users of Electronic Library Resources: An Overview and Analysis of Recent Research Studies. The Council on Library and Information Resources (CLIR) summarizes and analyzes more than 200 recent research publications (CLIR Report 1995 & 2003: Washington DC). These reports focus on the use of electronic library resources and were published between 1995 and 2003. Eight major ongoing studies (each with multiple publications) are identified as Tier 1 studies and are analyzed in detail, while about 100 smaller-scale studies are classified as Tier 2 studies and are examined together."

Wood, D.N. made a study in 1971 entitled "User Studies a review of the literature from 1966 to 1970". It was published in Aslib Proceedings, Vol. 23 Iss: 1, pp.11 – 23. Wood was asked to prepare the review of user studies to bring Fishenden's work up to date. This was published in the Journal of Documentation in September 1965 and his paper looks at a limited number of British use studies and draws some broad general conclusions relating to the development of a national information service. This study considers a wide range of investigations into the information gathering habits of scientists, engineers, social scientists and others, and reports results that it is hoped will provide managers with information on which to develop policies regarding library and information services at all levels. Although an increasing number of studies are being carried out in Eastern Europe and the USSR there has been no major work reported and consequently, the review considers mainly British and American investigations.

Lancaster, F.W. has made a study on the evaluation of library services: a concise review of the existing literature. Lancaster stated that the first serious attempt to develop objective evaluation procedures emerged in studies performed for the National Library of Medicine by Orr et. al. (1968).

User involvement in the design of computer-based information systems is enthusiastically endorsed in the prescriptive literature. However, determining when and how much, or even if, user involvement is appropriate are questions that have received inadequate research attention. A review of research was published online in 1984 in Management Science on user involvement and MIS success. The link between user involvement and indicators of system success is reviewed in the study. The authors find that much of the existing research is poorly grounded in theory and methodologically flawed; as a result, the benefits of user involvement have not been convincingly demonstrated. Until higher-quality studies are completed intuition, experience, and unsubstantiated prescriptions will remain the practitioner's best guide to the determination of appropriate levels and types of user involvement; these will generally suggest that user involvement is appropriate for unstructured problems or when user acceptance is important. To foster higher-quality integrated research and to increase understanding of the user involvement-system success relationship, the authors present the following: a conceptual framework into which previous research has been mapped that can provide direction to future efforts; a review of existing measures of user involvement and system success; a set of variables that have been proposed as potentially impacting the relationship between user involvement and system success.

3.8. SOME SELECTED DATABASE

There are a large number of studies conducted at the national and international levels on the concerned topic. They are published in various forms like books, journals, monographs, chapters in books etc. Some of the studies can be unpublished for certain reasons. It is very difficult to have all the studies on a single platform. The endeavours have been made to cover such studies in several databases. There are several databases consisting of full text and/ or indexing of books, journals, theses, pamphlets, proceedings, and research reports on various topics. Some of the popular databases are as follows:

3.8.1. Library Literature & Information Science (LLIS)

LLIS is a full-text bibliographic database that indexes articles and book reviews in more than 300 library and information science periodicals. Full-text coverage for 148 periodicals is also included. The indexing of books and chapters in collected works such as conference proceedings, library school theses, and pamphlets is also available in the database.

3.8.2. Library, Information Science & Technology Abstracts (LISTA)

LISTA provides full text for more than 330 journals and indexes over 560 journals, covering subjects such as librarianship, cataloguing, bibliometrics, online information retrieval, information management and more.

3.8.3. Library and Information Science Abstracts (LISA)

Library and Information Science Abstracts is an international abstracting and indexing tool. LISA is designed for library professionals and other information specialists. LISA currently abstracts over 440 periodicals from more than 68 countries and in more than 20 different languages.

3.8.4. ProQuest

ProQuest Library Science provides full-text access to over 150 core titles in the library and information science. It is also an authoritative Library and Information Science Abstracts database (LISA). It covers a range of titles relevant to the theoretical and applied study of library science, including trade publications aimed at the library profession as well as scholarly journals. This database offers complete text and images from journals such as:

- American Libraries
- Collection Building
- Reference & User Services Quarterly
- Technical Communication Quarterly; TCQ
- School Libraries Worldwide
- Portal: Libraries and the Academy

Image articles include all the charts, tables, diagrams, and other graphical elements often used to enhance the editorial value of articles that focus on education topics.

3.9. SOME OTHER IMPORTANT DATABASES

Some other important databases are also involved in making a collection of studies in library and information science.

- Dissertations Abstracts
- ERIC
- INSPEC
- Social Sciences Citation Index
- Web of Science

3.10. SUMMARY

The evaluation of library services was not so familiar before 1960. Virtually it was unknown but after 1960 several studies were conducted by so many authors like L.R. Wilson (1930), Ralph R. Shaw (1956), Krishna Kumar (1970), K. Saha (1978), P.S. Kawatra (1988), G. Devarajan (1989), Bawden (1990), M.S. Shridhar (1992) Baker and F.W., Lancaster(1991) and F.W. Lancaster (1993).

The review of users' studies can play a significant role in determining the direction of research for improving the quality of services provided by libraries for certain purposes. The review can also help make policies for further research or policymaking in relevant fields. We can compare information retrieval systems, web browsing, catalogue searching and so many information retrieval systems adopted by the libraries for their betterment or improving its quality.

The review of literature plays a significant role in research. The library has a key role in research and other developmental activities. The review of literature is very closely connected to the library. The library can't be ignored while making a literature review for the desired study. Here we have attempted to explain how to write a review of literature on user studies. We have also illustrated the need for a literature review on a user study. We have given some of the important national and international studies on users carried out by some agencies or individuals. The Library Literature & Information Science (LLIS), Library, Information Science & Technology Abstracts (LISTA), Library and Information Science Abstracts (LISA) and ProQuest are some selected databases highlighted in this study.

3.11. MCQ QUESTIONS

1. How many Ph D. were awarded by the Indian universities between 1950 -2012 on the topic 'Use and User Studies? ________

2. User study is concerned with: A. Use of information resources B. User's evaluation C. Users' need and behavior D. All of the above.

3. The selection of available documents A. both published and unpublished B. (published)C. (unpublished) D. None of the above

4. Review of literature may be carried out from ________ A. books. B. periodicals C. research articles from journals. D. All the above.

5'A literature review uses as its database reports of primary or original scholarship and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases, reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. Second, a literature review seeks to describe, summarise, evaluate, clarify and/or integrate the content of primary reports.' This definition is given by A. Cooper B. Hart, Chris C. Bruce. D. All the above.

6. 'The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background to and justification for the research undertaken (Bruce 1994). Bruce, who has published widely on the topic of literature review, has identified six elements of a literature review. These elements comprise a list; a search; a survey; a vehicle for learning; a research facilitator; and a report.' This definition is given by -A. Cooper B. Hart, Chris C. Bruce. D. All the above.

7. Library Literature & Information Science (LLIS) is a A. Full-text bibliographic database B. Library C. Society D. None of them.

8. What is LISTAA. Library, Information Science & Technology Abstracts B. Library and Information Service & Technology Abstracts C. Library Information System of Technical Advances. D. None of them.

9. What is LISA A. Library and Information Science Abstracts B. Library and Information Services in South Asia.C. Library Information System for Advancement. D. None of them.

10. Library and Information Science Abstracts is an international ---------------------tool. A. Catalogue B. a department C. abstracting and indexing. D. None of them.

11. ProQuest Library Science provides full-text access to over ---------------- in library and information science 150 core titles

12. How many Ph D. were awarded by the Indian universities between 1950 -2012 on the topic 'Use and User Studies? __________

13. User study is concerned with: A. Use of information resources B. User's evaluation C. Users' need and behavior D. All of the above.

14. The selection of available documents "_________" on the topic, which contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents in relation to the research being proposed.' A. both published and unpublished B. published C. Unpublished D. None of the above

15. Review of literature may be carried out from _____ A. periodicals B. books. C. research articles from journals. D. All the above.

16. 'A literature review uses as its database reports of primary or original scholarship and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases, reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. Second, a literature review seeks to describe, summarise, evaluate, clarify and/or integrate the content of primary reports.' This definition is given by -A. Cooper B. Hart, Chris C. Bruce. D. All the above.

17. 'The review of relevant literature is nearly always a standard chapter of a thesis or dissertation. The review forms an important chapter in a thesis where its purpose is to provide the background to and justification for the research undertaken (Bruce 1994). Bruce, who has published widely on the topic of literature review, has identified six elements of a literature review. These elements comprise a list; a search; a survey; a vehicle for learning; a research facilitator; and a report.' This definition is given by -A. Cooper B. Hart, Chris C. Bruce. D. All the above.

18. Library Literature & Information Science (LLIS) is a -A. Full-text bibliographic database B. Library C. Society D. None of them.

19. What is LISTA A. Library, Information Science & Technology Abstracts B. Library and Information Service & Technology Abstracts C. Library Information System of Technical Advances D. None of them.

20. What is LISA A. Library and Information Science Abstracts B. Library and Information Services in South Asia. C. Library Information System for Advancement. D. None of them.

3.12. SHORT QUESTIONS

Why literature review is important in a User Study?

What are the major sources to find literature on User Studies?

What are the major concerns of the User study?

3.12. LONG QUESTIONS

How to write a review of literature on user studies?

What is the need for a literature review?

KEYWORDS: Literature review; ProQuest; Web of Science

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UNIT 4

CATEGORIES OF USERS

4.0. OBJECTIVES

- o Meaning of Alternate Terms
- o Importance of User
- o Categories of Users
- o Characteristics of Users

4.1. OUTCOME OF LEARNING

After reading this unit, you will be able to:

- o To understand the alternatives for users.
- o To know the scope of various terms used synonyms to user
- o Acquaint with the importance of users.
- o Enumerate the various characteristics of users.

4.2. STRUCTURE OF UNIT

- o Introduction
- o Alternate terms for 'User'
- o Meaning of Alternate Terms
- o Importance of User
- o Categories of Users
- o Characteristics of Users
- o Summary
- o References

4.3. INTRODUCTION

Library and information centres collect, organize, retrieve and disseminate information to fulfil the needs of users. In the 21st Century, there is a paradigm shift in the functioning of libraries; now the libraries are more user-centred, focused and friendly. In earlier days, libraries were concerned to fulfil the need of the users in anticipation and/ or on-demand, but now the user is an integral part of all library processes and services. The user is no longer an outsider or just a recipient, as he was earlier, a silent service taker, but now the user is an active participant in all processes and services of libraries. The user in terms of library and information science may be readers of the library and all those who use the library for different purposes but in general, readers of the library are users. The library is called a trinity of –

- Readers,
- Reading materials; and
- Library personnel.

Here in this trinity user has been considered the most important constituent. All library activities are focused on catering to the information needs of the user. With the advent of information communication technologies (ICTs), various types of platforms are available and user services can be provided in real-time enabling the library professionals and users to work symbiotically and ensuring the seamless functioning of the library.

Indian library users have a very diverse and complex social profile. Users are influenced by their social background and cultural, political, and economic conditions. There are various terms used in various contexts to represent the concept of readers across the world. In this module an attempt has been made to define and describe various alternative terms in library and information science, Jennifer Rowley, Heidi Julien, Michael Gorman, BT Laloo etc. have attempted to differentiate these alternative terms.

4.4. ALTERNATE TERMS FOR 'USER'

In library and information science literature, various terms have been used to represent the concept of user. There are varieties of terms used in different contexts for users. These all terms reflect the same meaning and are interchangeably used for the term user with different connotations. These terms are enumerated alphabetically as below

- Audience
- Borrower
- Buyer
- Client
- Consumer
- Customer
- Patron
- Purchaser
- Reader
- User
- Visitor

4.5. MEANING OF ALTERNATE TERMS

In libraries and information centres various terms are used to represent the user. All terms have different meanings, scope, purposes and uses, though these terms which are used by different subject experts, are synonyms or near to synonyms to represent the concept. The definition of various key terms is given below:

4.5.1 Audience

The audience is a common term, which is used in library and information science too. This term is used in the context of public libraries and research activities. The audience is defined as “The group of consumers for whom a media text was constructed as well as anyone else who is exposed to the text"(Wilson, 2011). The definition is very wide. This definition reflects the media and information literacy context. Generally, the audience is viewers of any programme or show. Wikipedia says, "… an audience is a group of people who participate in a show..."

4.5.2. Borrower

According to ODLIS, a borrower is "a person who checks out books and other materials from a library. Most libraries require users to register to receive the borrowing privileges associated with a library card. ....The library privileges to which a borrower is entitled are indicated by the individual's borrower status."

The term is widely used in circulation activities or circulation counter of a library. In the context of the library’s functioning borrower, reader or user terms are synonymously used. Various other terms have been coined with the association of this term, for instance, the borrower’s card, the borrower‟ register, borrower account, borrower status, and borrowing period.

4.5.3. Buyer

Business Dictionary defines a buyer as a " party which acquires, or agrees to acquire, ownership (in case of goods), or benefit or usage (in case of services), in exchange for money or other consideration under a contract of sale."

Libraries are social institutions and are considered as not profit organisations; hence they do not come under the purview of business. The concept of marketing is now being applied in the operation of libraries. Some libraries and information centres are charging for their services, but charges are meagre and not for profit. So this term is not popular and frequently used in library scenarios.

4.5.4. Client

According to ODLIS, a client is "a person who uses the services of a professionally trained expert, or of a professional organization or institution, usually in exchange for payment of a fee. Librarians employed in academic and public libraries usually refer to the people they serve as users or patrons because libraries have traditionally provided most services without charge. Information brokers who operate on a fee-for-service basis can be more appropriately said to serve clients."

This definition elaborates the term and also describes the scope of the term in various contexts.

4.5.6. Consumer

The consumer is also a synonym for the user. Business Dictionary defines it as "1. A purchaser of a good or service in retail. 2. An end-user, and not necessarily a purchaser, in the distribution chain of a good or service." Generally, this term is not preferred in the literature of library and information science.

4.5.7. Customer

According to Business Dictionary, a customer is a party that receives or consumes products (goods or services) and can choose between different products and suppliers." Harrod's Librarians‟ Glossary and Reference Book define a customer. "…the user of a service; in particular the term implies that a financial transaction is taking place whereby a service or commodity is transferred to a purchaser."

The definition given by the Business Dictionary is more comprehensive and incorporates all types of consumers. Today this is fashionable to call information a product or a service and libraries provide information products and services to their readers. Most of the services are rendered free of cost by the libraries, in some cases, they charge but nominally.

4.5.8. Patron

This term is often used in libraries and library and information science literature. ODLIS defines a patron as „any person who uses the resources and services of a library, not necessarily a registered borrower. Synonymous with the user. "Generally patron means a person who donates or supports an organization.

4.5.9. Purchaser

Business Dictionary says that a purchaser is a "person or entity that is a recipient of a good or service provided by a seller under a purchase order or contract of sale."

Generally, this term is not used in library activities. Most of the library products and services are free of cost or charges are very nominal.

4.5.10. Reader

This is a core term frequently used in libraries. Generally, libraries have a reading room, in which readers read or consult materials kept for this purpose. Harrod's Librarians'‟ Glossary and Reference Book define a reader as a person who makes use of literary material in a library; a member of a lending library is frequently called a Borrower." The reader is a general term, which is frequently used interchangeably for the user.

4.5.11. User

A user is a person, who uses library and information resources for various purposes. It may be an individual, a group, an institution, or any other. It is to be noted that users' information needs could / will be different or vary from time to time and place to place. It must be remembered that in the changing world the information need is also changing very rapidly. This is more important how do LIS professionals frame or feel problems? If LIS professionals do not indulge in user studies, they would not be able to accurately forecast the future scenario. In libraries and information centres the terms user, reader, patron and borrower are frequently used for various purposes. In LIS literature these terms have been defined to differentiate their connotations.

4.5.12. Visitor

Dr SR Ranganathan used this term frequently in his writings. He expressed "visitors fall into two groups: those who want immediate attention.... and those who want to make an unhurried selection without too much assistance." (Ranganathan: Five Laws of Library Science: 74). This is a general term, a visitor who visits a place or someone or somewhere. Visitor visits the library and information centres to consult or refer to the material to fulfil /her information needs. This is a common term used for a user, who visits a library.

4.6. IMPORTANCE OF USER

Father of nation Mahatma Gandhi has said, "…a customer is the most important visitor on our premises. He is not dependent on us. We are dependent on him. He is not an interruption in our work. He is the purpose of it. He is not an outsider in our business. He is part of it. We are not doing him a favour by serving him. He is doing us a favour by allowing us to do so." This statement describes the whole philosophy of serving the people. LIS professionals should keep this statement in mind while serving the users." Customer is the King " is a slogan we listen to everywhere in the market. It shows the importance of users in the market. User satisfaction is the supreme and ultimate purpose of any library.

S.R. Ranganathan expressed his view on the importance of users in the library science profession, he said "you should not impose your ideas, your likes and dislikes on him ....Alas! we are all human and in trying to prove that we are right, we lose sight of our main object which is to help the visitor in finding out what he can use for pleasure and profit. Work with the reader. Don't work on him. You can lead him. But you can not drag him. Work with him on his ground." (Ranganathan, The Five Laws of Library Science).

User is a very important component of a library system or any information generation, exchange and utilization process. Information is a public resource or a common resource; it must be made available to all citizens on an equal footing. Library and information centres are deeply associated with the information generation, exchange and utilization process. This process can be made more effective and useful if users participate in this process. Now users are not only beneficiaries of services or passive actors in this process. In the 21st century‟s changed scenario, a user is an active part of any product or service. Now ICT has given a platform for reciprocity in the functioning of libraries and information centres. Libraries should understand the importance of the user and they must associate users in the planning of products and services rendered.

Today libraries are facing several problems; one of them is the dearth of users. Many people do not visit libraries to avail their services. The endemic nature of this problem in India can be realized by visiting any library. This problem can be solved by giving due importance to users. As users are beneficiaries of any information product and service ultimately, their opinion and feedback about the planning and execution of any service and product would associate more of them to the libraries. Users' needs must be satisfied by all means.

4.7. CATEGORIES OF USERS

It is very difficult to cover or limit the scope of the categories of users. Users may be categorised in various ways. How to capture or limit possible categories is a big challenge for professionals. In this module, an attempt has been made to give one dimension to understanding the wide and complex scenario of the phenomenon. Categories of the user may be divided based on some characteristics. The further categorisation may be done based on attributes.

The diagram given below shows the various categories of the users:

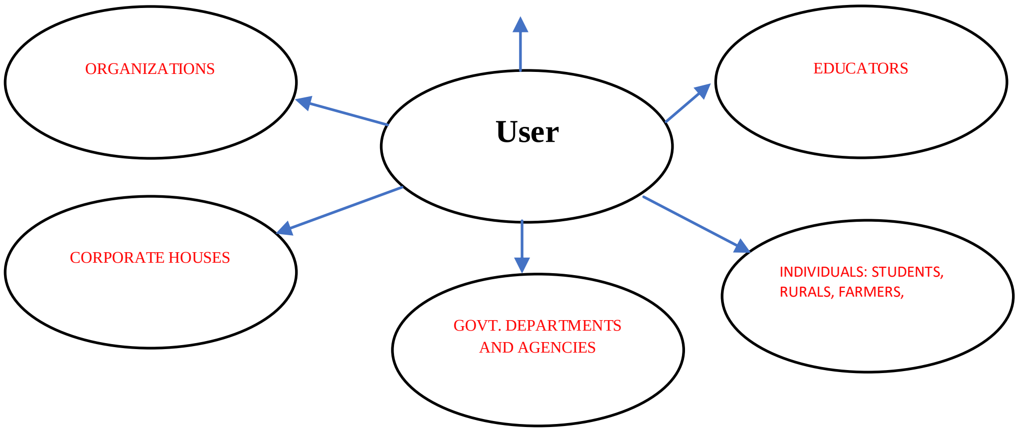

Diagram 1: Various categories of the users

In the following diagram, the term "person" is illustrated and various divisions, subdivisions and sub-sub divisions are enumerated based on different attributes. This chain of divisions can be enhanced in any direction by adding an attribute. For instance, in the following diagram term "person" has been further divided by literacy, gender, age, marital status and economic status. Then each division is again put under subdivisions. A map is ready to understand the scope of categorisation of users.

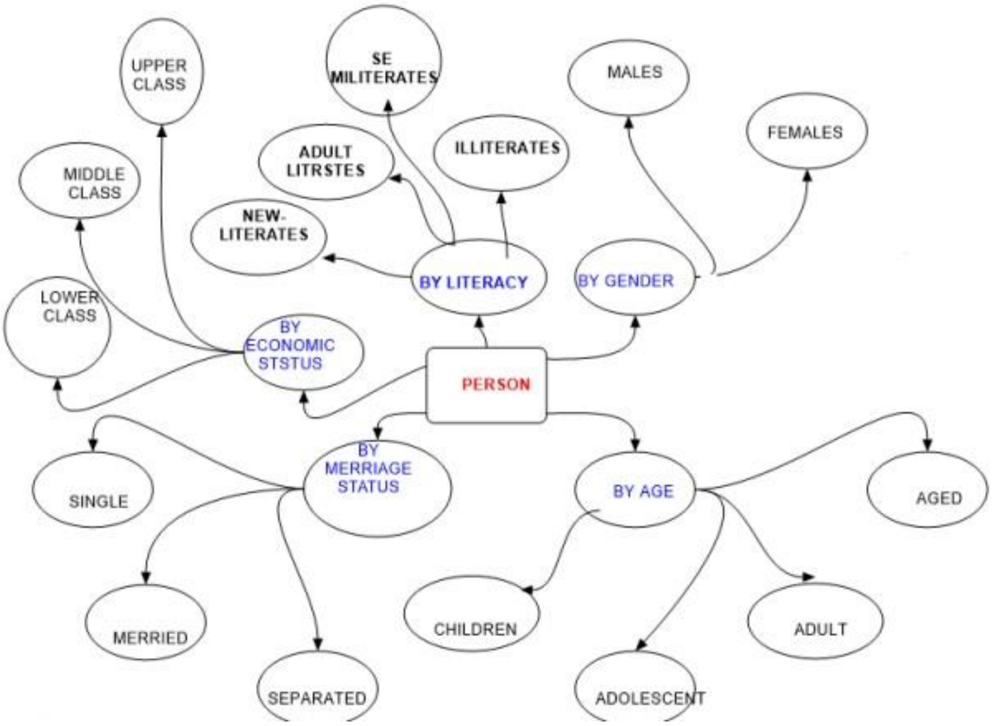

Diagram 2: Showing a categorization of the term " person" with various attributes

Categories can be made based on attributes or scope and the development of new knowledge. For example, Users can be categorized based on different kinds of disabilities as enumerated in Wikipedia

(< en.wikipedia.org/wiki/Disability<).

Categories of disabled users

- 1 Physical disability
- 2 Sensory disability
    - Vision disability
    - Hearing disability
    - Olfactory and gustatory disability
    - Somatosensory impairment
    - Balance disorder
- 3 Intellectual disability
- 4 Mental health and emotional disabilities
- 5 Developmental disability
- 6 Non–visible disability

Categories of students can be drawn based on various attributes, such as:

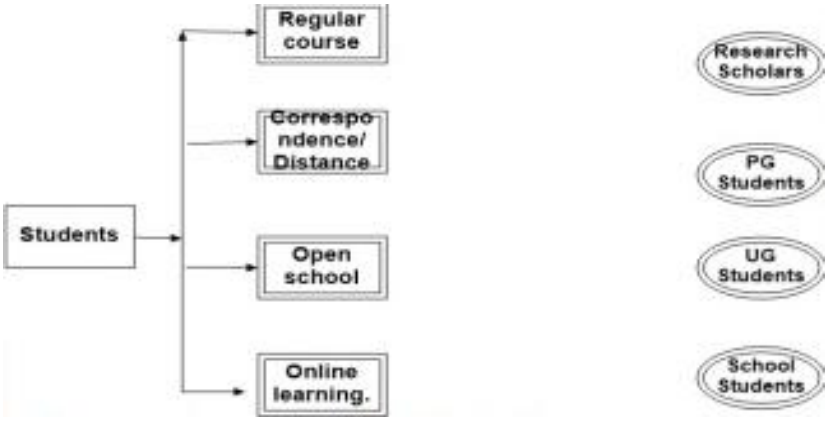

Diagram: 3 Categories of Students

Persons associated with educational activities, for example:

- Teachers: Teachers can be further categorised based on level of education:
- Universities: Professor, Associate Professors, Assistant Professors, Demonstrators
- Colleges: Associate Professors, Assistant Professors
- Schools: Postgraduate

Teachers, Trained Graduate Teachers, Primary Teachers.

Administration: Registrars, Finance Officers, Section Officers, etc.

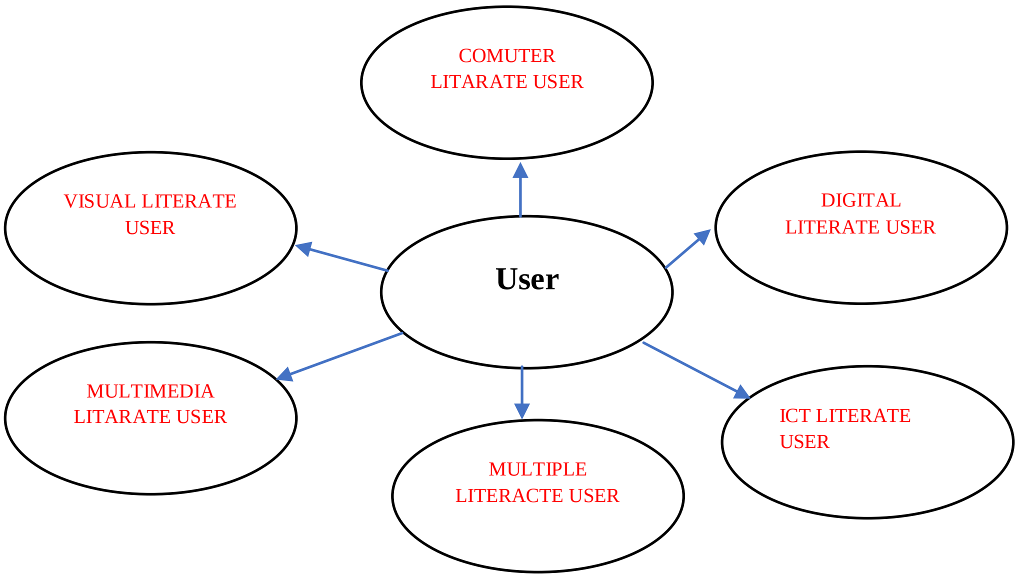

Diagram: 4 Categories of Users based on literacy

4.8. CHARACTERISTICS OF USERS

It is very difficult to enumerate all characteristics of users because the user is a blanket term, which incorporates a variety of attributes. Some of the characteristics may be:

- Social background
- Racial
- Ethnic
- Religious
- Cultural
- Social
- Economic
- Demographic
- Physical
- Mental

Every user has a specific kind of behaviour because the personality of a person gets affected by their religion, family values, demographic and geographical attributes, cultural environment and values that exist in that society. All these factors affect the information-seeking behaviour of the users. Users as individuals or as groups always have a specific kinds of features. Library and information science professionals should always keep in mind these characteristics. Accordingly, they can plan and execute various information products and services for the users. The ultimate task or function of any library product or service is to satisfy the ever-changing and ever-growing information needs of the users. If LIS professionals know the attributes of the users, they can plan products and services in a better way.

4.9. SUMMARY

The user is the most important component of library activities or information business. There are various alternative terms for the user, such as audience, borrower, buyer, client, consumer, customer, patron, purchaser, reader and user. All these terms have been defined and explained above. In this module, an attempt has been made to differentiate these terms. Categories of users have been enumerated and it has been explained how these categories can be multiplied by taking into account different attributes. Various characteristics of users, such as their social background, viz., their racial, ethnic, religious, cultural, social, economic, demographic, physical, and mental statuses among others affect their information-seeking behaviour.

4.10. MCQ QUESTIONS

1. The library is called a trinity of - A. Library Building, Reading materials and Library personnel B. Readers, Reading materials and Library personnel C. Readers, Library Committee and Library personnel D. Readers, Reading machines and Library Authorities

2. A person who makes use of literary material in a library; a member of a lending library is frequently called a Borrower. is expressed by: A. Wikipedia B. Business Dictionary C. ODLIS D. Harrod Librarians Glossary and Reference Book

3. The term ______ is widely used in circulation activities or circulation counter of a library. A. Borrower B. Customer C. Client D. Purchaser

4. "A customer is the most important visitor on our premises. He is not dependent on us. We are dependent on him. He is not an interruption in our work. He is the purpose of it......." is said by A. Philip Kotlar B. Mahatma Gandhi C. S R Ranganathan D. None of the Above

5. The library is called a trinity of -A. Library Building, Reading materials and Library personnel. B. Readers, Reading materials and Library personnel. C. Readers, Library Committee and Library personnel. D. Readers, Reading machines and Library Authorities.

6. “A person who makes use of literary material in a library; a member of a lending library is frequently called a Borrower.” is expressed by: A. Wikipedia B. Business Dictionary C. ODLIS D. Harrod’s Librarians’ Glossary and Reference Book

7. The term.................. is widely used in circulation activities or circulation counter of a library. A. Borrower B. Customer C. Client D. Purchaser

8"A customer is the most important visitor on our premises. He is not dependent on us. We are dependent on him. He is not an interruption in our work. He is the purpose of it......." is said by A. Philip Kotlar B. Mahatma Gandhi C. S R Ranganathan D. Melvil Dewey

9. Now .... has given a platform for reciprocity in the functioning of libraries and information centres. A. Information Technology B. Information Communication Technology C. Computer Technology D. Communication Technology

10. Which is not the alternate term used for users: ___________

11. “Person or entity that is a recipient of a good or service provided by a seller under a purchase order or contract of sale.” The statement is given by A. Hindi – English Dictionary B. Online Dictionary C. Business Dictionary D. Harrod’s Librarians’ Glossary and Reference Book

12. What is the full form of Library OPAC? A. Online Public Access Catalogue B. Online Publisher Access Catalogue C. Online Publicly Access Catalogue D. Online Publicly Available Catalogue

14. Access to electronic information in a variety of remote locations through a local online catalogue or other gateways. __________

15. Which is the national Union Catalogue of India? A. IndCat B. WorldCat C. UniCat D. BibCat

16. Union Catalogue Project initiated by ____ in the year 2002

17. Government Publications lists are released in A. Annual catalogue B. Annual Report of the concerned Ministry/Department C. National Library Newsletter D. Publishers catalogues

18. Catalogue of Government of India publications is a regular serial published every year. False/True

19. In the Library use studies the popular type of use study identified was: A. Library Routines B. Use of Card Catalogue C. Community Survey D. Above all

20. What is the main source of data employed in use studies A. Catalogue Use B. Circulation Transactions C. Bibliographic Sources D. None of the above

4.10. SHORT QUESTIONS

Define the importance of the user in a user study.

What are the three aspects of Library Trinity?

What are the characteristics of users?

4.10. LONG QUESTIONS

Mention six alternative terms of the user in the User Study.

What are the different categories of Users in user study?

KEYWORDS: Categories of Users, Characteristics of users

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UNIT 5

IDENTIFYING OF USER INFORMATION NEEDS

5.0. OBJECTIVES

- Understand what is needed?
- Enumerate the characteristics of information need
- Elaborate on the types of needs, and
- Discuss the meeting of information needs.

5.1. OUTCOME OF LEARNING

After reading this unit, you will be able to:

To define information needs, Types of needs

5.2. STRUCTURE OF UNIT

- Introduction
- What Need is?
- Meaning of Alternate Terms
- Definitions of Information Needs
- Characteristics of Information Needs
- Characteristics of Users
- Types of Needs
- Meeting Information Needs
- Summary
- References

5.3. INTRODUCTION

Identification of information needs is a prerequisite to designing and developing any information system to provide need-based information services to the users. In earlier times before the systematic beginning of user‟ studies during the 1940s, the generation of library services was mostly based upon professional perception without gathering factual data on the information needs of users Nevertheless, the libraries have been always aiming at serving the users in the best possible way by providing them with the desired reading resources they are likely to use. With the advances in the library profession, it was felt that empirical data should be collected from the various communities and groups of users to generate and provide need-based effective and meaningful services to the prospective users. In India, S R Ranganathan (1933) particularly through his Five Laws of Library Science brought to the conscious level of library professionals that users are the focal point and every activity of the library profession revolves around them. He brought forth how the messages embedded in his laws could be complied with to serve the users in the most effective manner and ways. The philosophy emanating from these laws emphasizes that users have to be always kept in sight while building resources and services. To quote Taylor (1986) The „principal strength of value-added model lies in its stress on the user and the needs and dimensions of the information environment as a major element in the design and evaluation of the system."

It has been a great concern of the profession as to how user-centred services could be generated and disseminated. A mismatch between the resources and the user's needs must be minimized as far as possible. This presupposes that information professionals must know the users' information needs they will serve. Further, they should also know how people seek, retrieve and prefer to use information. When we think of marketing information, we must first know our clientele to have the salability of our information products. The producers or the generators of any product should always produce such commodities that meet the day-to-day needs of prospective consumers without any barriers and drudgery. Information user is happy when he gets what he/she is looking for. To achieve this, the users' information needs are first identified before planning such services (Chandel, Saraf, 2004).

According to Wilson (1980), perfect knowledge of inquirer is predictions and perfect knowledge of all texts, which could be used by an inquirer, would be necessary before that ideal set could be identified. For the library, it is important to investigate the preferences of its users to be able to acquire adequate information sources (Vilar and Zumar, 1995)"...a knowledge of the requirements of the different users of scientific information and the uses to which they wish to put the information they secure should be the ultimate determining factor in the designing of methods of storage and retrieval of scientific information." (Bernal, 1959).

Before this module is further elaborated, let us attempt to define and understand the connotation of „needs‟. According to Karl Marx, need is a psychological concept, and a human being is a creature of need. These needs are to be satisfied to avoid complications and unpleasantness and remove uncertainty. Need is a requisite which is required or wanted or desired. Need is a necessity such as food, water, security, etc.

5.4. WHAT NEED IS?

Defining needs is difficult. But the human being is a creature of need as stated by Karl Marx. Even philosophers have avoided and neglected the definition of need (Reader, 2005). Ohlsson (1995) observed that there are two concepts expressed by the term „need‟ – one referring to certain psychological drives and one referring to certain casual connections between states. The psychological drives of Ohlsson are similar to Maslow's theory of hierarchy of needs (1943).

Dictionary meaning of need is a condition or situation in which something is required or wanted, e.g., I need a glass of water. Business Dictionary defines „need‟ as a motivational force that compels action for its satisfaction. Needs range from basic survival needs (common to all human beings) satisfied by necessity, to cultural, intellectual, and social needs (varying from place to place, and age group to age group).

We need food, and shelter to survive. People need health care. But there is a difference between the need for food and health care. Anything, which is necessary but lacking leads to the generation of need. These needs are due to lack of and deprivation of something which are to be satisfied in order to avoid unpleasantness, remove anxiety and feeling and move on to a higher level need. Other terms used as synonymous or near synonymous with „needs‟ are requirement, demand, want, and preference. Needs are contingent, and wants and preferences in contrast are contingent (Ohlsson, 1995). When some demand is put to seek something, it implies that there is a need behind this demand. So we may infer that demand is also the expression of need. The difference between wants and needs has been summarized as (McCain,2012):

5.5. DEFINITIONS OF INFORMATION NEEDS

The concept of information needs was first time used by Robert (1962). Taylor attempted to describe how an inquirer obtains an answer from an information system, by performing the process of seeking information consciously or unconsciously (Wikipedia). However, Menzel (1964) preferred the term „demand‟ in place of „need‟. Our collection development policy is also based on demand theory. In all literature of Library& Information Science, mainly two terms have been frequently used, i.e. Information needs and information-seeking behaviour.

It is not only the information needs of users exclusively which is to be met, libraries are also expected to meet the requirement, demand and want of the users. Users may put a demand on the system to get information, may require some piece of information or want to read and consult some information resources which may not be based upon their actual needs. Therefore, for the purpose of this study, „information needs‟ should be considered in a broader perspective which also includes information requirement, want and demand of information, though differences among these terms have been discussed in the preceding paragraphs. Information needs are not the basic need as needs for food, shelter and health care.

Information-seeking theories often refer to the concept of information needs, a presumed cognitive state wherein an individuals need state triggers the search behavior characteristic of information seeking in a given context (Design dialogues, Nov. 15th, 2010). On a day-to-day basis, people engage themselves in information seeking at some level (consciously or unconsciously) (Krikelas,1983). When an attempt is made to define information needs, both the terms „information‟ and „need‟ should preferably be defined individually for a better understanding of the concepts of the two terms. But both these terms are difficult to define, as such there is no consensus on defining these terms. Need is an internal process and information is a nebulous term. In view of this situation, Wilson (1981, 2005) suggests that the term „information needs‟ be abandoned and replaced with the term „information-seeking behavior.‟ He writes (2005): that the term "information-seeking behavior" should be adapted in place of information needs as behaviour is observable, whereas needs being internal mental states, are not." „Information needs‟ and „information seeking behaviour‟ cannot be treated as conveying the same meaning, nor information needs can be adapted to mean information seeking behaviour and vice versa. When information need is felt, the process of information seeking begins. In other words, information needs to generate information-seeking or information-gathering behaviour. Information-seeking behaviour includes how users look for information, how they make use of resources, what are their preferences, and choices, how they interact with the barriers of information communication and information systems in use, how they perceive their needs and formulate search strategies to access information (Chandel, 2004). This makes the difference between „information need" and „information seeking behaviour". But the argument of Wilson is convincing in order to resolve the issue by replacing information needs with information-seeking behavior to come out of the complexity in defining „information need". But the meaning and the concept of both the terms are different.

Belkin (1977) gave the concept of an Anomalous State of Knowledge (ASK). He identified the fundamental problem of communication between information generator and information user and concluded that the cognitive level of the recipient of the information is anomalous with respect to some goals. ASK is similar to the unconscious need of Taylor (1968) when the user is not able to conceptualize what he actually needs. However, it may not be true in all cases. When reference is made to unconscious need, unexpressed need, and anomalous state of knowledge, it is difficult to bring „information need" under a precise definition. When people recognize a gap in their state of knowledge, that is, when they experience "an anomalous state of knowledge", they wish to resolve that anomaly and seek information. But libraries are not supposed to meet the information needs only but have to provide all resources whatever is required or demanded or /wanted by the users. The following statements may explain the difference among terms like need, demand, requirement, preferences and wants which almost convey the same meaning so far as meeting information needs is concerned:

i) There is a demand for course books as observed by the library staff. ii) Survey revealed that the majority of the users above the age group of 60 years like to read religious books. iii) In public libraries, users often look for recreational and inspirational materials. Users often want to read new arrival and new publications in their area of interest. People need digital libraries in the 21st Century. I need the morning newspaper to begin the day. iv) Local history is one of the subjects of interest of the local community.

Krikelas defines information needs as a state of uncertainty recognized by an individual (Henefer, and Fulton,2008). Information needs are felt in different circumstances encountered by the individual. Information is also sought even without the feeling of its „need". It is not always need-based. One may search for information out of inquisitiveness to know the latest advances in the subject, and resolve problems at hand relating to work one is engaged in. Information is also sought for recreational, inspirational and motivational purposes which do "t fall under the category of human basic needs. One may also gather information to keep updated and influence people around him with his knowledge. Some people have an instinctive derive to seek information to go on changing their knowledge structure and keep themselves abreast with the latest developments. Therefore, „information need" is to be considered in a broader sense which includes want, demand, preferences, and choices for information resources.

5.6. CHARACTERISTICS OF INFORMATION NEEDS

- Main characteristics of information needs could be summarized as below:

- Information needs are subjective as well as objective with an inter-relationship between the two. Needs are objective because it is a discoverable matter of fact what needs a person has.
- Needs differ from individual to individual, group to group, institution to institution, society to society, environment to environment, and from time to time conditioned by the purpose and function at hand (Chandel and Veena, 2004).
- Need-Creating Events/Environments are responsible factors behind information needs and information gathering (Krikelas, 1983).
- Nature and types of information needs differ according to the purpose at hand and the situation in which it arises.
- Information needs are often non-specific, and intangible. visceral and thus unknowable and non-specifiable in a query to an information system (Belkin, Oddy, and Brooks, 1982).

5.7. TYPES OF NEEDS

There are different types of needs conditioned by the different purposes at hand. The environment in which one works or in which one lives will have bearing on the type of information one needs as well as one defines that need. Voigt (1959) identified only three types of needs: The current approach (to keep up-to-date), the Everyday approach, and the Exhaustive approach. Menzel (1964) added one more function to Voigt's list of enabling a scientist to „brush up on a field – that is to familiarize himself with the more or less well-defined field of inquiry. The need may also arise from isolated events (Henefer and Fulton, 2008). Krikelas (1983) believed in only two types of needs; immediate needs and deferred needs. Whittaker (1993) gave the following types of information needs:

i) Regular: Such as current awareness, browsing of subject journals.

ii) General: General reading according to the interests hobbies etc.

iii) Quick reference: Fact-finding, statistical information.

iv) Relating to personal problems: Travel, diagnosis of diseases, finding a job, etc.

v) Personal development: Study abroad, qualifying competitive examinations and improve professional competence.

vi) Research: Writing thesis, project report, dissertation, literature survey and review, etc

Gorman (1995) identified the following types of information needs:

i) Unrecognized: not aware of information or knowledge

ii) Recognized: aware that information needed may or may not be pursued

iii) Pursued: information seeking occurs, may or may not be pursued

Taylor (1962) identified the following four stages in the minds of the inquirer when asking four types of questions, giving rise to information needs:

i) Actual, but unexpressed, need for information (the visceral need)

ii) The conscious, within-brain description of the need (the conscious need)

iii) The formal statement of the question (the formalized need).

iv) The question as presented in the information system (Compromised need).

Orr (1970) gave a detailed account of types of information needs. He identified why of information needs based on input and output functions which are given below:

5.7.1. Input Functions

5.7.1.1. Regular Needs

- Current Awareness: To keep abreast of new development.
- Everyday Reference: To obtain specific items of information essential for the day-to-day conduct of an ongoing project.
- Personal: Such as food, drinks, etc.
- Stimulation: Suggest new ideas, approaches and problems.
- Feedback: To obtain reactions to own work and refine problem definitions.

5.7.1.2. Episodic Needs

- Retrospective: Search to learn of past work possibly relevant to and useful for current or project.
- Exhaustive: All relevant work.
- Limited: Limited by size or by criteria (e.g., literature of last 10 years).
- Instructions: To acquire new competencies or to „brush up" in areas where competency has declined.
- Consultation: To obtain tailor-made „solutions to or expert opinions on specific problems recognized as outside areas of special competence.

5.7.2. Output Functions

5.7.2.1. Responding

This is in response to the input needs of the users which may be explicit or implicit. The output response could be:

- Informing
- Alerting (Current awareness)
- Answering (Everyday reference)
- Referring (Retrospective search)
- Teaching (Instruction)
- Advising (Consultation)
- Reacting to meet personal needs

Requesting: To solicit input from others explicit or implied requests aimed at meeting own needs for current awareness, everyday reference, retrospective search, instruction and consultation, as well as for stimulation and feedback.

- **Promoting:** To advance own ideas, projects, career, or reputation, namely:
- **Proposing**: To obtain support from sponsors, collaboration and cooperation from others.
- **Preempting**: To establish a proprietary „claim" for contribution, pending definitive disclosure or "registration".

- **Registering**: To make a contribution part of the permanent record esteemed by reference groups or sponsors.
- **Re-enforcing**: To improve the chance of achieving the desired end by citing your own contribution, etc.
- **Defending**: To refute criticism.

Types of information needs depend upon the nature of the problem at hand which varies from individual to individual in different circumstances. The very purpose of going into the details of types of information needs is to find ways and means of meeting these needs to the utmost satisfaction of different types of users belonging to different communities by generating such services which have relevance to the users. Some writers distinguish information needs according to the activity in which information gained is used, Menzel (1964). Knowledge of different types of information needs provides background to generate different types of services for different types of users. Today‟s users are entirely different to earlier users of two or three decades ago. Internet and Google experience have changed the information-seeking behaviour of the users. They expect everything in a single click irrespective of the location and possession. Most users today want comprehensive information in full text.

5.8. MEETING INFORMATION NEEDS

The classification of information needs is quite diverse as discussed above and it is quite challenging to meet the varied needs of different types of users. Any type of need or demand can confront the professional who should be ever prepared to meet the situation. Menzel (1964) identified three themes to provide expected services to the scientists to meet their requirements which have the same relevance today as 50 years ago:

The guiding slogan must be speed, efficiency and comprehensiveness. The overriding aim in other words is to bring information to the scientist promptly, to bring him all that is relevant, and to bring it to him with a minimum of waste motion, especially on the scientist's own part.

- The prototype activity is an exhaustive search. This means the delivery to the scientist of all documents satisfying a small set of criteria that he has defined in advance.
- The achievement of these goals lies along the roads of greater systematization, greater streamlining, greater mechanization, and greater automation of information processing and dissemination.

Though these were conceived as untested themes and assumptions but have passed through the test of time and seem to be proven facts. During the 1960s there was hardly any application of technology to achieve the above goals which Menzel had very thoughtfully conceived and foresighted. In the present electronic age, nothing can be achieved without systematization, mechanisation and automation. These are the roads leading to reaching library users to meet their information needs.

It is interesting to note that IFLA (2011) used the term wishes of the users in place of the needs of the users.

5.9. SUMMARY

The purpose of identifying the information needs of users is to provide need-based value-added information services. Users are always to be kept in view and emphasis should be on their needs which also include demand, wants, preferences and also wishes. A large number of literature have been published on user studies, particularly on „information needs‟. The precise definition of information needs is still lacking. Information need is not similar to needs for food, shelter, healthcare, etc. Information needs are not the basic need. If information need is not satisfied, it may not lead to consequence as being starved without getting food or not getting healthcare. Information is not only sought when needed, however, but users may also seek information for recreation, to keep themselves up-to-date on their subject of interest. Many users out of their hobby also seek information. They may be driven to find information out of curiosity and interest which may not fall strictly under the definition of need. Information is sought when one feels that his knowledge is not adequate than required to meet the situation, this inadequacy has to be removed by providing the right information.

We have discussed different types of needs of different users which obviously have different sources and services to be generated and provided. The basic function of the library begins with collection building, if it is developed based upon „needs", resources would be used. Therefore, identifying the information needs of users plays an important role in providing need-based services.

It is also equally important as to how these services should be provided. Google and other service providers' search engines have attracted library users and the majority of our users are being withdrawn away from the libraries. Convenience and ease of use are dominating factors. User information-seeking behaviour has entirely changed, and their dependence on libraries is declining. Therefore, it is not only important to assess the information needs of the users, but it is equally important how to provide services to them according to their expectations. Information needs to be interpreted in a broader sense of the term so that whatever is sought is provided timely and effectively provided. It hardly matters whether it is demand or wants or need.

5.10. MCQ QUESTIONS

1. The concept of ASK (Anomalous knowledge) was given by: A. N J Belkin B. R S Taylor C. J D Bernal D. T D Wilson

2. Who made the following statement? Information-seeking behavior should be adopted in place of information needs as behaviour observable whereas needs being internal mental state …A. Melvin Voigt B. N Robert C. T D Wilson D. N J Belkin

3. Who gave the concept of information needs for the first time: A. T D Wilson B. M B Line C. R S Taylor D. Herbert Menzel

4. Identification of information needs helps in: A. Dissemination of information B. Generating need-based information services C. Developing a good circulation system D. Solving problems relating to knowledge management

5. Internet and Google/ books and periodicals experience have changed the information-seeking behaviour of the users. ___________________

6. Information-seeking theories often refer to the concept of information needs, a presumed physical/cognitive state wherein an individual's need state triggers the search behavior characteristic of information seeking in a given context. ___________

7. T D Wilson suggests that the term ‘information needs’ be abandoned and replaced with the term……………………………A. information demand B. information requirement C. information want D. information-seeking behavior

8. The concept of information needs was first time used by Robert (1962). True/False

9. Needs do not differ from individual to individual, group to group, institution to institution, society to society and environment to environment. True/False

10. Belkin (1977) gave the concept of an Anomalous State of Knowledge (ASK). True/False

11. ACRL stands for _______

12. The digital collections of the research outputs created within a university or research institution are known as ___________

13. DOAJ is the abbreviated form for ___________

14. OAI-PMH is Open Archives Initiative ___________ for Metadata Harvesting.

15. The abbreviation for Public Library of Science is ____________

16. Open DOAR is run by ____________

17. ETD stands for _______________

18. _____________ are pre-peer-review articles

19. OA can be achieved only by following the green route. True/False

20. Scholarly communication includes only formal means of communication, such as publication in peer-reviewed journals. True/False

5.11. SHORT QUESTIONS

Define Information Need?

Enumerate the characteristics of information need.

Give four characteristics of information need.

What do you understand by Episodic need?

What are the characteristics of users?

5.12. LONG QUESTIONS

What is an example of information need explain in detail?

What are the types of information needs?

KEYWORDS: Information need; Characteristics of users; Episodic need

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UNIT 6

ASSESSMENT OF INFORMATION NEEDS OF DIFFERENT USER GROUPS

6.0. OBJECTIVES

- Understand what is need?
- Enumerate the characteristics of information need
- Elaborate on the types of needs, and
- Discuss the meeting of information needs.

6.1. OUTCOME OF LEARNING

- To understand the concept of information and information needs.
- To know the information needs of different user groups.
- To know how the information needs of the different user groups are assessed.

6.2. STRUCTURE OF UNIT

- Introduction
- What is information?
- Types of information
- What is information need?
- Levels/categories of information need
- Types of information needs
- Dependency on information needs
- Information needs of different user groups
- Information needs of social scientists
- Objectives of studying information need
- Assessing or determining the information needs
- Role of the library in information needs
- Summary
- References

6.2. INTRODUCTION

The term information need is often understood as an individual or group's desire to locate and obtain information to satisfy a conscious or unconscious need. Rarely mentioned in general literature about needs, it is a common term in information science. According to Hjørland (1997) it is closely related to the concept of relevance: If something is relevant for a person in relation to a given task, we might say that the person needs the information for that task.

6.3. WHAT IS INFORMATION?

The term Information is derived from two Latin words 'Forma' and 'Formation' which mean to give a shape to something and form a pattern. Information is considered a basic need which can be found in primary, secondary and tertiary sources. But what information really is? Madden (2000) mentions that information has occupied the thoughts of information scientists for a long time almost certainly before the term 'information science' was coined in 1955.

It is generally seen that information, data and knowledge are used synonymously but they are different.

- **Data** - Data are the raw material for information but they can be expressed numerically and are quantified, quantifiable, tabular or objective. Data are also repetitive in nature.
- **Information** - Information is the raw material for knowledge but like data, information is not highly repetitive or can be quantified or quantifiable. It may be also characterized as narrative, subjective, qualitative, textual or descriptive.
- **Knowledge** – When information is adequately assimilated, it becomes knowledge. Similarly, Needs, Wants, Demand and Requirements are used interchangeable but they differ.
- **Needs** – This is the want of something, which one cannot well do without.
- **Wants** – A state of the fact of being without or having an insufficient quantity, absence or
- deficiency of necessities.
- **Demand** – It is required, asking for what is due or asking for something.
- **Requirement** – It is a need, a thing needed or a necessary condition.

Thus, the uses of the above terms clearly reflect the fact that there is a lack of exclusivity and they are used interchangeably, though they differ from each other.

While Random House Dictionary (1983) mentions that information is “knowledge communicated or received concerning a particular fact or circumstances: any knowledge gained through communication, research, instruction.

Webster’s Dictionary (1989) defines information as the news or intelligence communicated by words or in writing, facts or data, or knowledge derived from reading or instruction gathered in any way.

Information is defined variously by other scientists as given below:

Weisman (1972) has defined information as knowledge, intelligence, fact or data that can be used, transferred, or communicated. It can be derived from experience, observation, interaction and reading.

To Bhattacharyya (1978) the information is the message conveyed or intended to be conveyed by a systematized body of ideas, or its acceptable substitutes.

Feynman (1996) says that “Information is not simply a physical property of a message: it is a property of the message and your knowledge about it.”

McCreadie and Rice (1999 a,b) have presented information concepts under the following heads
after reviewing fifty years of summary of information work.

- **Information is a Representation of Knowledge** – Information is stored knowledge. Traditionally storage medium has been booked but increasingly electronic media are becoming important.
- **Information as Data in Environment** – Information can be obtained from a range of environmental stimuli and phenomena; not at all of which are intended to convey a message but which can be informative when appropriately interpreted.
- **Information as Part of Communication** – Meanings are people rather than words or data. Timings and social factors play significant roles in the processing and interpretation of information.
- **Information as a Resource or Commodity** – Information is transmitted in a message from sender to receiver. The receiver interprets the message as intended by the sender. There may be added value as the information is disseminated or exchanged.

Madden (2000) is of the opinion that the information should be “a stimulus originating in one system that affects the interpretation by another system of either the second system’s relationship to the first or of the relationship the two systems share with a given environment”.

6.4. TYPES OF INFORMATION

Information has been divided into the following types (Shera, 1972):

- Conceptual Information that is related to the idea, theories, and hypotheses about the relationship which exists among the variables.
- Empirical Information that is related to experience and data of research which may be drawn from oneself or through communication from others.

- Directive Information that is used for coordination and for enabling effective group activities.
- Policy Information that is focused on the decision-making process.
- Stimulatory Information that is motivated by oneself or environmentally derived.
- Procedural Information that includes the data of investigation which are obtained, manipulated and tested. It is essentially methodological and it is derived from a scientific attitude.

6.5. WHAT IS THE INFORMATION NEED?

The concept of "information needs" is difficult to define, isolate and measure because it "involves a cognitive process which may operate on different levels of consciousness and hence may not be clear even to the inquirer himself (Kumar et al., 2011)". Burnkrant (1976) proposes that need is "a cognitive representation of a future goal that is desired". However, information needs to arise in a person as a reaction to a stimulus (Timmins, 2006). The stimulus can be due to major life changes, other events or life-threatening or incapacitating illnesses and these can be perceived as a challenge to threat, depending upon the novelty, timing in life and the level of uncertainty or unpredictability about the event. Individuals display two major coping mechanisms – managing the problem that is problem-focused coping and regulating their response that is emotion-focused. It is problem-focused coping which includes information seeking where an individual tries to get help, inhibiting action and taking direct action. It is this information seeking that creates the information need.

Faibisoff and Ely (1976) mention that the term Information Need has become an umbrella under which a variety of interpretations fall. They further add that if information needs are considered as a generic concept then there are subsets which address information demand (or requirements) and information wants (or desires). There are individuals who can articulate demands and there are those who have a desire for information but are not able to specify what it is that they need. Here, the definition of information demand is easy which can refer to the demands that may be vocal or written and made to a library or to some other information system. But defining information wants is a tough task- it may be synonymous with demands or something else.

Information Need term is variously defined by different scientists from time to time. A systematic

A review of the definition is presented below:

Paisley (1968) says information need is not a psychological state of mind rather it is an objective need oriented towards particular tasks, problems, etc.

Rawley and Turner (1978) state that information needs are "any piece of information recorded as well as unrecorded, that a scholar may need (as distinct from want, demand and use) in connection with his study, teaching and research activities.

Belkin, et al. (1982) are of the opinion that information need is an anomalous state of knowledge.

Chen and Hernon (1982) define information needs as "that which arises whenever individuals find themselves in a situation requiring knowledge to deal with a situation". It may arise in all aspects of life, the home, the office, in a relationship or at work.

To Ogunrombi and Marama (1998), information need is absolutely necessary to the management of information centres/libraries. Information becomes useful only when it is packaged in the right format; delivered to the right user at the right time.

Forsetlund and Bjorndal (2001) have defined information need as “any stimulus that reduces uncertainty in a decision-making process”.

However, Adewumi (2003) submits that information needs vary with users, time, purpose, location, alternatives available and so on.

Girja Kumar (1990) has defined information need in detail as an “input – process – output model, where the basic components of the system are – problem, problem-solving process and solution”. The problem is analyzed to determine information needs. It is indicative of uncertainty in knowledge.

Solution results in resolving the situation by filling the gap in the knowledge. Thus, information needs are variously stated but may be summed up as the desire of any individual or group to locate and obtain information to satisfy a conscious or unconscious need.

6.6. LEVELS/CATEGORIES OF INFORMATION NEED

Taylor (1962) has listed four levels of information need:

The conscious and unconscious need for information does not exist in the remembered experience of the investigator. In terms of the query range, this level might be called the “ideal question” — the question which would bring from the ideal system exactly what the inquirer, if he could state his need. It is the actual, but unexpressed, need for information.

The conscious mental description of an ill-defined area in the decision. At this level, the inquirer might talk to someone else in the field to get an answer.

A researcher forms a rational statement of his question. This statement is a rational and unambiguous description of the inquirer’s doubts.

The question is presented to the information system.

Taylor (1991) again has identified the following eight classes of information use [need] as under:

- Enlightenment
- Problem Understanding
- Instrumental
- Factual
- Conformational
- Projective
- Motivational and
- Personal or Political

But these categories are not mutually exclusive, so that information [need] used in one class may also address the needs of other classes.

Weigts et al. (1993) have suggested the following categories of information need:

- Need for new information;

- Need to elucidate the information held; and
- Need to confirm information held.

Thus, it is clear that despite the varying differences in the emphasis and definition, there is consensus that information needs are linked to specific situations and that needs arise when the present level of knowledge is limited to deal with a new situation. But it is true that needs emerge from three kinds of motives as proposed by Morgan and King (1971):

- Physiological motives (for example, hunger and thirst)
- Unlearned motives (including curiosity and sensory stimulation), and
- Social motives (the desire for affiliation, approval or status, or aggression), which accords in part with Wilson's analysis of needs being cognitive, affective, or physiological.

6.7. TYPES OF INFORMATION NEEDS

Menzel (1966) has divided the information need into the following three types:

- Preference to demand studies which include opinions, evaluations request for information and experiments on the impact of a service.
- Use studies, which include relative contributors of communication channels and critical incident studies.
- User interaction with dissemination in systems, as in studies of the flow of information at a scientific meeting.

While Tague et al. (1976) have presented the following types of information needs:

- Social pragmatic information needs to be required for coping with day-to-day life.
- Recreation information needs.
- Professional information needs.
- Education information needs.

6.8. DEPENDENCY ON INFORMATION NEEDS

Information needs of the users depend upon work activity and the availability of facilities and discipline. Voigt (1961) has recognized three types of users' information need dependency or approaches as under:

- **Current Approach** – where a user deeps himself side by side with the latest development in his own field of information.
- **Everyday Approach** – it is to meet users' frequently information needs during their research investigation.
- **Exhaustive Approach** – Where a user wants almost all the relevant literature on a problem.

While according to Crawford (1978), information needs to depend on:

- Work activity
- Discipline/ Field / Area of interest
- Availability of facilities
- Hierarchical position of individuals
- Motivation factors for information needs
- Need to take a decision

- Need to seek new ideas
- Need to validate the correct ones
- Need to make professional contributions
- Need to establish priority for discovery etc.

Thus, dependency on information needs may be of various kinds. But information needs are affected by a variety of factors (Paisley, 1968), such as:

- The range of information services available.
- The users to whom information need to be put to use.
- The background, motivation, professional orientation and other individual characteristics of the user.
- The social, political and economic system surrounding the user, and
- The consequences of information use.

However, the need for information is a factual situation that may exist as a separate interconnection between information and need. Information originates and is generated because there exists an interest and a need. The content of information is of primary concern but the information objectively realizes a function. Such information needs of users have to be satisfied.

6.9. INFORMATION NEEDS OF DIFFERENT USER GROUPS

It is noted that though everyone uses some information, only fundamental and applied researchers generate new information by experiment while relying heavily on existing data to produce new materials. Most of the scientific information is highly specialized and is recorded in a language that only a few trained people can understand. While, social scientists generally need conceptual information in print format but their focus lies on statistical information, descriptive information and analytical or interpretative information.

Information needs can be determined on the basis of the following questions (Wilson, 1977):
Does this person or group need information (Influencing factor - Social role)
Does he know he needs information (Influencing factor - Problem recognition ability)
What kind of information does he need (Influencing factor – Level of performance of the role, nature of specific problem environment)

However, these questions are difficult to answer because they imply that, the people who need information may not have defined the need.

6.10. INFORMATION NEEDS OF SOCIAL SCIENTISTS

Economics, Sociology, Anthropology, Political Science, Psychology, History, Public Administration, and Social Work subject. But ICSSR has clubbed about eighteen categories of fields under the purview of Social Sciences, which include Economics, Commerce, Education, Management, Business Administration, Political Science, International Relations, Psychology, Public Administration, Sociology, Criminology, Social Work, Anthropology, Demography, Geography, History, Law and Linguistics (Atal, 2003).

Social scientists according to Line (1969) are extremely print-oriented and they preferred statistical, methodological and conceptual information. Kumar et al. (2011) have presented a review of literature on the information sources that social scientists need. This may be consulted for details.

6.10.1. Information Needs of Pure / Applied Scientists

Science is an area of knowledge, typically about something in the physical world that can be explained in terms of scientific observation or the scientific method. Generally, the following branches are covered in a pure science (http://www.infoplease.com/ipa/A0880382.html):

- Physical sciences, which deal with matter and energy and allow us to describe the material universe in terms of weight, mass, volume, and another standard, objective measures.
- Earth sciences, which explain the phenomena of Earth, its atmosphere, and the solar system to which it belongs.
- Life sciences, which describe living organisms, their internal processes, and their relationship to each other and the environment.

Besides, there are applied sciences which include Engineering & Technology.

Bernal (1960) has identified seven categories of uses of scientific information, they are:

- Fundamental Scientific Researchers
- Applied Scientific Researchers and Developers (agricultural, engineering and medical)
- Technologists (agricultural and medical practitioners, architects and engineers)
- Teachers, Students and Report Writers
- Interested Public
- Historians of Science

Scientists and technologists are in constant need of information. Voigt (1961) has identified three approaches but generally, there are four different types of information requirements or approaches from them. These are:

1. Current approach that arises from the need to keep up, to know what other workers in the field are doing.
2. Everyday approach arises in the course of daily work, regularly and frequently, usually in the form of a need for some specific piece of information vital for further progress.
3. Exhaustive approach arises when work begins on a new investigation, and involves a check through all the relevant information on a given subject.
4. Catching up or Brushing up approach or Browsing approach that is unplanned, and certainly inefficient. It is nevertheless a fruitful path to information, definitely part of the scientific and technological communication system.

Sahu et al. (2014) have discussed some of the major information needs of Scientists and Engineers. This document may be consulted for details.

Besides, there is the general public that also needs information. However, the majority of the general public may not be able to conceptualize their information needs but they are too inferred and must be satisfied.

Further, children also have information needs which vary from that of young and older people. They are also to be satisfied. Recently, it is observed that information needs and information-seeking behaviour is changing with the "ICT involvement" (Dhiman, 2003; Dhiman and Rani, 2012).

Kadli and Kumbar (2013) have presented a very good literature review on the changing pattern of information access and information-seeking behaviour in the ICT environment. This must be consulted for assessing information needs and to satisfy the needs of different types of users.

6.11. OBJECTIVES OF STUDYING INFORMATION NEED

The main objectives of studying information needs according to Lipetz (1965) are:

- The explanation of observed phenomena of information use or expressed needs;
- The predication of instances of information use;
- The control, and thereby improvement, of the utilization of information through manipulation of essential conditions;
- The description of observed information use;
- The definition of convenient and appropriate concepts for description and dealing with information use; and
- The theorizing of casual or quantitative relationships between information use ad associated factors.

6.12. ASSESSING OR DETERMINING THE INFORMATION NEEDS

Moore and Cordes (1992) define needs assessment as "any systematic approach to collecting and analyzing information about the educational needs of individuals or organizations." Needs may be perceived, imagined, desired or thought to be important or real. A needs assessment can also be identified as a gap, the difference or distance between what is occurring in practice and what is expected (the desired outcome), or, the difference between what is and what should be.
Commenting on the assessment of needs, Wilson (1981) mentions that need is a subjective experience that occurs only in the mind of the person in need and, consequently, is not directly accessible to an observer. However, there have evolved various methods for assessing the information needs of the users, but the major ones include the following.

- Interview
- Questionnaire
- Observation

6.12.1. Interview

An interview simply means a conversation with a purpose. According to Young (1961) interviewing is an interactional process with others who has a mutual view of each other. The interview may be a self-administered, face-to-face or telephonic interview or maybe through video conferencing. A self – administered interview can be had through a self-administered format which is distributed and get back via mail. These formats may also be a part of an experimental procedure or delivered and picked up by hand. While in the face-to-face interview, the assessor can ask more questions about specific needs. A telephonic survey exists between the interviewer and the person being interviewed and is cheaper than face to face interview but it can be reached more widely. However, there is a somewhat greater sense of anonymity over the phone, particularly if the assessor randomly selects the information seekers. Besides, now a day, interviews can be held through video conferencing. This provides a quick and instant assessment of information needs.

6.12.2. Questionnaire

A questionnaire is a list of questions sent to a number of persons for their answers and which obtain standardized results that can be analyzed statistically. The questionnaires are also one the important tools for assessing the information needs of the users. Though they are mainly made up of a list of questions, but may also include clear instructions and space for answers or administrative details. Questionnaires are commonly used for to gather straightforward information relating to people's needs and to look at the basic attitudes and opinions of a group of people relating to a particular issue.

6.12.3. Observation

Observation is a systematic process of recording behavioral patterns of people, objects, and occurrences as they happen. "Seeing" and "listening" are the two most important keys to observation. The observation may be further participative or non-participative types. Participative observation requires that the observer become a participant in the culture or context being observed. This type of observation is used most commonly for qualitative needs. Whereas in non-participative observation, the observer does not try to become a participant in the context, however, he does strive to be as unobtrusive as possible so as not to bias the observation.

There are merits and demerits of each method. It is a general opinion that questionnaires and structured interviews are the best methods for quantifiable data but the standardized form of a questionnaire cannot always reveal a user's unique experience. Further, the questionnaire leaves no way to determine the respondent's mood at the time or to clarify ambiguous questions or answers. But the interview can do these things, however, it is more expensive and time-consuming. But one of the major drawbacks of both questionnaire and interview methods is common – they cannot collect actual data on behaviour, as it happens.

6.13. ROLE OF LIBRARY IN INFORMATION NEEDS

The information needs of the users have to be satisfied by the library and information centres through their services. The information needs to relate to:

(i) Which information is needed, i.e., the theme or subject? It presupposes that any and all information about the requested subject will somehow satisfy the information need.

(ii) The other approach is rather different. It might be called a situational approach, where users want information on a certain subject. What can be done to satisfy this need? What does he want to know, at which level of details and abstraction etc? This specifies the intrinsic characteristic of information whatever the subject may be.

Information needs assessment is the first step in any search. This small investment of time at the beginning of a search will save a great deal of time in the long run. Needs assessment is a careful consideration of the questions "What kind of information do I need?" and "Where might I find such information?" Every information need has two types of components (http://www.utoledo.edu/library/mulford/pdf/assess.pdf):

- Subject components address the topic of the information need, such as "prevention of knee injuries in high school athletes" or "the role of patient education in preventing complications in high-risk pregnancy".
- Format components relate to the type of information needed, such as review articles, books, items published within the last five years, etc. The format can be determined based on the type of information needed (such as cutting-edge information or

background knowledge) or by an outside factor (such as a professor requiring research articles).

Table 1: Types of Resources used for Specific Kinds of Information

Questions	Considerations and Suggestions
What information do I need?	Write down your information need in narrative form. Consider the type of information you need: background, current, statistical, etc.
That is the main topic?	Identify the key topic(s) of your search.
Can this main concept be represented by any other terms?	Generate synonyms for your key topic(s).
What are the supporting concepts?	Consider aspects such as therapy, diagnosis, aetiology, etc. Consider also the population, such as infants, baby boomers, African-Americans, women, etc.
Can the supporting concepts be represented by any other terms? Or by a feature of the system?	Generate synonyms for your supporting concepts. If you already have an idea of which resource you will use, consider features of that system (subheadings, limits).
What format is needed? Can a feature of the system represent this?	Consider internal and external determinants of the format. (See above for more information on format components.)

Once the need has been assessed, then an appropriate information resource must be selected. The table given above provides an overview of the types of resources that can be used to find specific kinds of information. Further, it is also seen that more and more information is available in the market due to the explosion of information at the global level, therefore management of libraries is necessary to meet the information needs of users.

Libraries are the best centres for satisfying the information needs of different classes of users. Therefore, Zhang (1998) rightly stresses the thorough understanding of user information needs and information-seeking behaviour that is fundamental to the provision of successful information services, so that the information needs of different types of users could be satisfied well.

6.14. SUMMARY

Information that arises as a curiosity is considered a basic need which can be found in primary, secondary and tertiary sources. While information needs are the requirements for the data or knowledge of any kind that is desirable or necessary to conduct the teaching or research. The paper/chapter may be concluded in the words of Wilson (1981) who mentions that what in fact is meant by information needs is information behaviour. Though both are complimentary of each other but also somewhat different. Information need arises due to psychological motives, uncleared motives or social motives but where information needs end, information-seeking behaviour starts to satisfy these needs.

6.15. MCQ QUESTIONS

1. When information is adequately assimilated, what does it becomes? A. Data B. Knowledge

C. Facts D. Phenomenon

2. Who told that information as knowledge, intelligence, fact or data that can be used, transferred, or communicated? A. Weisman B. Feynman C. Bhattacharyya D. Madden

3. Who said the information needed is not a psychological state A. Rawley and Turner B. Ogunrombi and Marama C. Chen and Hernon D. Paisley

4. Conceptual Information is related to which of the following: A. idea, theories and hypotheses about the relationship B. experience and data of research C. data of investigation D. enabling effective group activities

5. Hunger and thirst is the example of which types of motives. A. Physiological motives B. Social motives C. Uncleared motives D. Cleared motives

6. Physical science deals with: A. The matter and energy B. the phenomena of Earth and its atmosphere C. the living organisms and their internal processes D. the plants and their internal process

7. Who has given the seven categories of uses of scientific information? A. Wilson B. Bernal C. Crawford D. Voigt

8. Who has suggested the following categories of information need? A. Taylor B. Weigts et al C. Morgan and King D. Adewumi

6. Evaluation of Web-Based Library Instruction Programs can be done through A. Questionnaire B. Field Study C. Heuristic Evaluation D. Diary Method

7. Cognitive Walkthrough method can be applied with A. First-time user B. Regular User C. Ordinary User D. None of the above

8. In Which method a story is created to understand the problems of the users? A. Computer feedback B. Scenario-based Design C. Internet Browsing Pattern D. Citation Analysis

9. Use Study methods can be classified into A. Formal and Informal Methods B. Technical and Non-Technical C. Conventional and Non-Conventional D. None of the above

10. Any technique of user study should be conducted with a systematic. A. Methodology B. System C. Planning D. Management

11. A longitudinal study is a cross-sectional study, in this method researchers conduct several observations, and surveys of the same subject over _________ A period of time B. A Year C. A Month D. Subjects

12. Functional analysis is used to understand ....of users. A. Interest B. Behaviour C. Information. D. Needs

13. How many stages are involved in a Use study process? ________

14. Workshop method involves _______ with users. A. Motivation B. Participation C. Discussion D. Alienation

15. Cognitive Walkthrough is an ________ method. A. Interactive. B. Discussion C. Motivation. D. Survey.

16. ACRL stands for A. Association of Community and Research Libraries B. Association of Culture and Research Libraries C. Association of College and Research Libraries D. Association of College and Revenue Libraries

17. The term _________ first appeared in print in a 1974 report by Paul G. Zurkowski. A. Digital literacy B. Information literacy C. Media literacy D. Computer literacy

18. Information literacy aims to make people educationally literate. False /True

19. In simple terms, information literacy means finding, evaluating and using the information in an appropriate way False /True

20. The Prague Declaration of 2003 states that "Information literacy encompasses knowledge of one's information concerns and needs and the ability to identify, locate, evaluate, organize and effectively create, use and communicate information to address issues or problems at hand; it is a prerequisite for participating in the information society and is part of the basic human right of life long learning" False /True

6.16. SHORT QUESTIONS

What is Information?

What are the different types of information?

What are the different types of surveys according to Ackroyd and Hughes?

When to adopt Observation/field study?

6.17. LONG QUESTIONS

How many stages are involved in a user study process?

Write two differences between Data, Information and Knowledge.

What do you understand by the Current Approach to Information needs?

Write down the aspects of Conventional methods of a user study.

KEYWORDS: Information need; Observation; Information

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UNIT 7

METHODS AND TECHNIQUES OF USER STUDIES PART- 1
METHODS AND TECHNIQUES OF USER STUDIES PART- 2

METHODS AND TECHNIQUES OF USER STUDIES PART -1

7.0. OBJECTIVES

- Methods of Use Studies

- Techniques of Use Studies
- Analysis of Library Records

7.1. OUTCOME OF LEARNING

- To know the importance of user studies.
- To know about the types of methods of use studies.
- To know about the techniques of use studies.
- To understand various methods and techniques of use studies and to understand what type of technique(s) are useful and when and how they can be applied or conducted,
- To understand conventional and unconventional, direct and indirect, and general and special methods of use studies,

7.2. STRUCTURE OF UNIT

- Introduction
- Methods and Techniques of Use Studies
- Summary
- References

7.3. INTRODUCTION

In the field of medical science, pure sciences and even in applied sciences experiments have to be performed to see the result or it is done on regular basis to change the result or to face certain new upcoming challenges. Same manner User Studies are being performed in libraries and information centres on a regular basis for examining, planning and forecasting; because by using empirical evidence, library administration can solve maximum problems regarding managing and administering a library. The activities of the libraries are totally depending on the user's needs and requirements and it is better to understand their problems and expectations so that the services of the libraries could be improved according to the user's expectations.

The success of every library depends on "Use" and "User", "use" is a reason and "user" is the main element of the system. Use is the key point and `User' is the key and dynamic component of every library and information system. Use Studies is the most important aspect while designing/examining a library system or library services, and also necessary to perform periodically. The user studies help to discover characteristics, behaviour, information needs, attitude and opinion about the system and services. The main factors viz., psychological factors, the effectiveness of services, characteristics of the users, and the environment are necessary to include in any type of user study. Even some time demographic characteristics like age, education level, specialization, and research interest were also undertaken for this type of study. Moreover, some more characteristics may appear before the investigator at the time of user studies because it varies from place to place, time to time and also depends on the problem on which the user study is being undertaken.

The topic "Methods and Techniques of Use Studies" is hereby presented in two modules, Module 7 and Module 8, Module 7 covers the conventional methods of use studies and Module 8 covers the latest methods of use studies and which are new but useful as conventional methods. Module 8 also covers the steps involved in conducting user studies.

7.4. METHODS AND TECHNIQUES OF USE STUDIES

There are many reasons to conduct user studies. Studies can be used to evaluate the strengths and weaknesses of various services of the library. There are several methods and techniques for conducting use/user studies, and many authors have expressed that the methods being used for social science research can be applied to user studies. Use studies may be descriptive or prescriptive depending upon the situation. According to Guha4, user studies methods are General or Conventional methods, indirect methods and special and unconventional methods; these methods can be further classified as:-

- General or Conventional Methods include questionnaires, interviews, diaries and observations.
- Indirect methods include Library Records Analysis and citation analysis.
- Special and Unconventional Methods include computer feedback and, it can be further extended by studying the internet browsing patterns of the users and the internet behaviour of the users.

PSG Kumar 5 has explained that the user's studies can be classified according to the types of the library such as Public Library, Academic libraries and Special libraries because the clientele and the reading material and other aspects of each type of library are different and, in such condition, no particular criteria can be adopted for each and every type of library.

The other types of user study are Users Oriented, System-Use Oriented and Utility Oriented.

7.4.1. Questionnaires

Questionnaires or social survey is a very important tools to collect empirical data and standardized data from large numbers of people, they can collect the same type of information from the population or sample in the same way. In the questionnaire method data collected from the population or sample can be converted into numbers and then calculations can also be made with the help of statistical methods to get the results.

Ackroyd and Hughes 6 have identified three types of surveys:

- Factual survey: used to collect descriptive information, i.e. the government census
- Attitude survey - i.e. an opinion poll
- Explanatory survey - test theories/hypotheses and/or produce a new theory.

Researchers usually use questionnaires or surveys in order to make generalizations; therefore, the surveys are usually based on carefully selected samples. Questionnaires should be:

- Filled in by the participants
- Asked in a structured and formal way by an interviewer
- Postal questionnaire can be used,
- Telephone questionnaire
- Email questionnaire.

The main advantages of the questionnaire methods are economy, Uniformity of questions and Standardization. Further, the questionnaires can be used in different forms such as Closed or restricted, Open or unrestricted and Structured or unstructured.

7.4.2. Interviews

Interviews are particularly useful for getting the story behind participants' experiences. The interviewer can pursue in-depth information about the topic. The interview is a more flexible form than the other methods of user studies. It is more useful if intelligently used. The interview method can generally be used to gather information of greater depth. The interview may be formal and informal, a personal meeting and conversation with the interviewee just to obtain personal information or insight about the library service or services. There are two main types of interviews namely Face-to-face interviews and Telephone interviews, and both methods can be undertaken in a structured and unstructured way.

7.4.3. Diary Studies

This method involves a diary which is distributed to the users or the library can request the users to keep a record of their activities, experience and while actively using the library. This type of method can be used to have User experience and initiation of new service to collect the insight of the users in context to their daily routine. The users' entries in the diary may have a variety of details such as facts, opinions, and problems related to experiences with library services. A diary can also be used in the collection development process. The same method can also be applied in online mode. The diary method may help in exploring the following:

- Existing usage behaviours and mindsets
- Current engagement paths
- Reading Interest.
- Discover the regular habits of the users
- Surface frustrations,
- Inherent obstacles and barriers
- Unmet needs and desires

7.4.4. Observation and Field Study

Observation means to examine just by "seeing" and "listening" any activity, observation extends the facility to examine activities, behaviour and physical aspect without the permission of participants of the study and can all be documented. Observation is appropriate in the following conditions:

- Need for direct information.
- Need to understand behaviour, process, situation or event.
- Need to examine physical evidence, products or outcomes.
- Other research methods seem inappropriate.

The observation method can be used in two ways, direct observation and indirect observation. Direct observation involves active participation of the participants which means participants know that they are being observed. In Indirect observation, method participants do not know that they are being observed and both methods have their own limitations, merits and demerits.

"A field study is a collection of data that occurs outside of an experimental or lab setting. This type of data collection is most often done in natural settings or environments and can be done in a variety of ways for various disciplines."

The field study research method is a qualitative method, carried out in a usual environment, not in a controlled environment, evidence is collected and analyzed on the field only.

"Field reports require the researcher to combine theory and analysis learned in the classroom with methods of observation and practice applied outside of the classroom. The purpose of field reports is to describe an observed person, place, or event and to analyze that observation data in order to identify and categorize common themes in relation to the research problem(s) underpinning the study. The data is often in the form of notes taken during the observation but it can also include any form of data gathering, such as photography, illustrations, or audio recordings."

7.5. ANALYSIS OF LIBRARY RECORDS

This method is an internal method and can be performed without interfering and interrupting the user's activities in the library, this study can be done through checking of records of issues and return of books/reading material, analysis of visitors registers, analysis of visitors registers of reference section or of any section of the library where the visitors' register is maintained, computer records of the users, register of interlibrary loan, checking of library website hits. The best advantages of this system are it is the most economical, no extra person is required to perform the analysis, and can be done on regular basis etc.

7.5.1. Computer Feedback

The latest tool in the field of user study, computer feedback is the process or specific instance of providing information through the computer about products and services. B. Jean Mandernach12 has identified the five types Computer Feedback of computer feedback, which can be utilized to collect users' responses such as:-

- No feedback through this method users' responses can be obtained without addressing any individual questions;
- Knowledge-of-response feedback through this users responses can be obtained about the correct/incorrect status of each question, but it does not inform students about the correct answer;
- Knowledge-of-correct-response through this user's responses can be obtained about the correct/incorrect status of each question, but provide the correct answer.
- Topic-contingent feedback through this users responses can be obtained about the correct/incorrect status of each question along with a paragraph of information from where the correct answer can be found;
- Response-contingent feedback addressed the correct/incorrect status of each question along with an explanation of the selected response and the correct response.

7.5.2. Analysis of Computer Records

The present scenario of libraries and information centres is better in comparison to the earlier state of functioning and servicing because every service and function of the library is totally dependent on the computers, in this sense, every library has to keep detailed records of the users and its behaviour such as Personal Details of the Users, Academic Status of the Users, Subject Interest, Circulation Records, Reference Queries, Searching Behaviour of Users, Interlibrary Loan Records, Use of Reading Material, Use of Services/Equipment, Acquisition Behaviour etc.

The analysis of computer records is an indirect method and can be done on regular basis without interfering with the daily routine of the library and users, the analysis can be conducted to get the results about users' preferences in terms of age, qualification, interests, information seeking behaviour and collection policy of the library and on any criteria which demand to be studied.

7.5.3. Internet Browsing Pattern

All type of information is available in digital form and most of the information is also available online, and the libraries and information centres are harvesting all types of services for their users, and in this age, the libraries are having its own website and providing access to their users through this. Moreover, some libraries are providing information through other databases. In this era, it is necessary to study their users about their internet browsing patterns. This study examines whether the users are fully satisfied with the internet facilities of the library, whether the objectives of the internet facility are being fulfilled or not, are users have awareness of the information in the internet environment, and other characteristics pertaining to the internet. This type of study can be conducted online or offline or can be conducted through logging patterns of users; using patterns and time spent on the internet just checking the server logging reports.

7.6. SUMMARY

The library is unable to satisfy the needs of users completely without user feedback, and this purpose cannot be fulfilled only by the library administration and this cannot be initiated by users themselves, in this problematic situation users' study is very useful and beneficial for the library as well as for users too. The user's studies are a very important aspect of every library, the development plans, further extension and initiation of new services totally depend on it, the above-mentioned methods and techniques are very useful tools to assess the status and satisfaction in reference to library service.

METHODS AND TECHNIQUES OF USER STUDIES PART- 2

7.0. OBJECTIVES

- Other Techniques of Use Studies
- Longitudinal studies
- How to Conduct a Use Study

7.1. OUTCOME OF LEARNING

To understand others techniques of use studies, apart from conventional methods. To recognize the method of use study. To know all steps are needed to conduct user studies. To know about how to handle the process of use studies and how to report or implement the outcome of use studies.

7.2. STRUCTURE OF UNIT

- Introduction
- Other Techniques of Use Studies
- Longitudinal studies
- How to Conduct a Use Study
- Summary
- References

7.3. INTRODUCTION

The use studies can be conducted in a number of ways to identify what users want from a library. The methods given in the previous module are the methods which are being used continuously in the libraries and information centres, and these methods are conventional types of methods, and the methods/techniques given in this module are not popular but are being used to gather the data of use/user studies in a meaningful manner and have a scientific background. This module covers discuss Functional Analysis; Empathic Modelling; Scenario based Design, Cognitive Walkthrough, Heuristic Evaluation, Focus Groups, Workshops and Longitudinal studies. This module also presents a description of How to Conduct a Use Study, and the process of the use study involves identifying the Problem, Setting Objectives, Step 3: Selecting a Suitable Technique, Collecting data, Analyzing data and Reporting. The main object of this module is to present the unconventional methods of use studies and to familiarize the students with the process of use studies.

7.4. OTHER TECHNIQUES OF USE STUDIES

Apart from the methods discussed in the previous module, some more methods are given below, these methods are very useful and can be used as and when required and the situation arises so:-

7.4.1. Functional Analysis

Functional analysis is commonly used to better understand behaviour, this is a decision-making approach which is broken down into its components such as circulation, reference/information service documentation service, etc. These services can also be divided into sub-components or parts of the service. This is necessary to solve the problem or know the status of the service from the user's point of view. Functional analysis can be performed on a group of users to know the status of the new service or the service being provided by the library, this can be performed in two ways First informed consent, Second this can be performed without informed consent. If users are informed then they should know about the characteristics of the library service; the user group; the purpose of the study and the process of the service. Prior to this Library Staff Research, Scholar or Agency should discuss the functionality of the service which is in question. After completing the study the result should be notified to the concerned regarding the feasibility of the service. Functional Analysis focuses on two main aspects Target Group/ Users and the purpose of the service (new or old).

7.4.2. Empathic Modelling

Empathy stand for the deep emotional understanding of another's feeling about any problem or situation, and empathic modelling can also be applied in the user study. In this type of user, the study research scholar has to put himself in the position of the user at one point and observe or examine or understand difficulties faced while using the different library services. It is a better way to judge the problem of the users instead of a judge through some artificial means. It is very useful to understand the problems being faced by the users while using the services of the library, such as problems in the circulation system, reference service, information service, documentation service, and on any service of the library. This method hales to get a fast easy impression of the problem.

7.4.3. Scenario-based Design

Scenario Based Design is a very practical kind of method, in this, the Library Administration has to create a story on the basis of a task, suppose a library wants to judge how a user searches his information, for that a story has to be built involving tasks to be performed, like first inspect catalogue/inspect through the computerized catalogue (online/offline), search book/periodical/online information, satisfied or not, if yes task is over if not then again go through the whole process. This method can be applied in each and every sphere of library activities. Text and drawings can be used to describe the scenario. The core of library user studies designed scenario is a description around a user, trying to achieve a task goal involving user study within a given context environment. The effectiveness and efficiency of any service can be assessed by this method.

7.4.4. Cognitive Walkthrough

The cognitive walkthrough method is used to identify usability issues in any interactive systems, and it is also applicable in libraries. It has been observed that sometimes users tend to learn or handle on their own rather than reading manuals, and instructions given by the libraries. The cognitive walkthrough is a very useful method to conduct user study and this is useful when it is applied to first-time users and what kind of problems he/she encounters while completing a task or understanding the task. This cognitive walkthrough method is developed in a structured way, which means every step is predefined because the scholar/library/designer has to examine the task while walking through and question themselves the following questions:-

- Will the user know how to carry out the task?
- Will the user notice the elements to use?
- Will the user understand the information on the interface?
- Will the user receive feedback after every action?
- This method can be applied to the new library and any new service which is going to be initiated by the library.

7.4.5. Heuristic Evaluation

Heuristic evaluation is a kind of informal method, developed by Nielsen and Molich in 1990. This method can be applied when we want to examine or recognize the possibilities of failure according to the users' point-of-view with respect to their purposes. Heuristic evaluation is simply looking into an opinion about what is good and bad, Nielsen and Molich have developed the following nine basic usability heuristics:-

- Simple and natural dialogue.
- Use the language that the user understands.
- Keep the user's memory load to a minimum.
- Be consistent.
- Provide feedback.
- Provide shortcuts.

- Provide clearly marked exits.
- Prevent errors.
- Good error messages.

This method can be applied to studying users to examine the possibilities of failure or success of any library service. Heuristic evaluations of the users required skilled evaluators because it involves direct interaction with the users. Nielsen recommends that this heuristic evaluation should include at least three to five evaluators and they should have expertise in the design and the system which is being evaluated.

In the field of library and information science, several studies have been conducted like website designing of a library, User-oriented evaluation of library and information centre Web sites, feasibility study of the digital library and Evaluation of Web-Based Library Instruction Programs.

7.4.6. Focus Groups

A focus group can be performed with group interviews or group discussion, in this method the participants are to be expected to be end users of the library and the services being provided by the library. The researcher or evaluator has to introduce the topics of the study or discuss the library and its services and through this interaction undertake users' views. The whole interaction or discussion is well designed and contains all questions and aspects on which the users' views have to be undertaken. Focus groups are a useful method to:

- investigate complex behaviour
- discover how different groups think and feel about a topic and why they hold certain opinions
- identify changes in behaviour
- investigate the use, effectiveness and usefulness of particular library collections and services
- verify or clarify the results from surveys
- suggest potential solutions to problems identified
- inform decision-making, strategic planning and resource allocation
- to add a human dimension to impersonal data
- To deepen understanding and explain statistical data.

A focus group is an exploratory, guided interview and interactive conversation with participants on common interests or characteristics. The main object of the focus group is to obtain the result of hypotheses about what users expect towards particular services of the library, sometimes complex issues and behaviour can also be included in the focus group. Moreover, the library can organize several Focus group studies on a particular topic or area to obtain a broader view of users. Focus group can be conducted offline and online mode, and it has been found that several studies follow this method, which is Usability testing of an academic library website; Use and users of electronic library resources; and From the other side of the reference desk.

7.4.7. Workshops

Workshops which bring stakeholders together like experts and users in a creative setting to discuss new ideas, design options, costs and benefits, screen layouts and other things relevant for design, development and application. Starting from critiques of the situation the fantasy and wishful thinking should bring forward new ideas and a collective view which are then evaluated and – if appropriate - used for further steps.

Design workshops help to facilitate communication and increase the awareness between users and designers or developers. A group of professionals and end-users together can interact to trigger ideas. Designed workshops are being broadly used in participatory and interactive design. They extend participants a chance to experience new concepts and technologies. Normally workshops consist of different activities including discussions, generation of ideas and implementation of simple prototypes.

7.4.8. **Longitudinal studies**

A longitudinal study is a cross-sectional study, in this method researchers conduct several observations, and surveys of the same subject over a period of time, sometimes lasting many years and the researchers should not interfere or alter the subject and the criteria except for the time. In this method, the researcher is able to observe the development and the changes in the attributes of the target group/population after every fixed interval of time. Libraries of the University of Southern California 4 are regularly conducting users study and explained that: -

- Longitudinal data allow the analysis of the duration of a particular phenomenon.
- Enables survey researchers to get close to the kinds of causal explanations usually attainable only with experiments.
- The design permits the measurement of differences or changes in a variable from one period to another [i.e., the description of patterns of change over time].

Longitudinal studies facilitate the prediction of future outcomes based upon earlier factors. The same method can be applied in any library and information centre because every library has to observe all important aspects of service at every interval of time, such as users' approach towards reading material to develop the collection development policy of the library.

7.5. HOW TO CONDUCT A USE STUDY

The method of user study depends on the policy of the Library or its administrator, the library can conduct users on its own or can conduct it through any outsource agency. How data of users study is gathered and analyzed depends on many factors, such as the types of users, area of users study, service to be analyzed, initiation of new service, etc. Every study should be conducted in an ethical way, participants should be informed in advance and should be allowed to maintain their privacy. It is better to gather information through accepted data collection techniques to maintain the authenticity of the user's study and to protect the credibility and reliability of user's study.

7.5.1 Step 1: Identify Problem

The first step is to identify the problem or issues to be investigated in the library, it is helpful because the process of identification of problem extends the better understanding of what to be examined to assess the internal and external environment of the library, the problems and the issues may vary from library to library. It is helpful to conduct an internal and external assessment to understand what is happening inside and outside of your organization. The problems or issues may be related to the user study on Users' Behaviour, Users Satisfaction, Research Behaviour or any.

7.5.2. Step 2: Setting Objectives

At this stage organization or Library has to determine whether the user's study will be done on single problems or multiple problems. The library has to set certain objectives to complete this study; it may include why this study will be conducted and what are the priorities of this study. The specific goal(s) has/have to define for issue/issues.

7.5.3. Step 3: Selecting Suitable Technique (s)

The whole result of the study depends on the suitable research technique, thus the library may opt for any method or technique for data collection, this may be a qualitative or quantitative method or further may select any technique such as questionnaire method, observation, interview etc. The following points can be considered for selecting of proper research technique:-

- Who will collect the data?
- What will be an area of comparison?
- What locations?
- How should data be collected?
- Qualitative data
- Quantitative data
- What sources should be used to collect data?
- Pre-existing or official data
- Survey data
- Focus groups and interviews
- Observed data
- What should be the timeframe for the study?

7.5.4. Step 4: Collecting data

After due consideration of the research technique, the agency/library has to collect data, implementation of the data collection plan requires the attention of the following points:-

- Data collection through own employee or through outsourcing.
- Identifying the population/sample
- Maximum participation of the population/sample.
- Protecting the privacy and personal information

- Minimizing the inconvenience for the population/sample.
- Choosing the best time to collect the data?
- Flexibility.
- Consider a test period to allow you to improve/ modify data collection methods.
- Distribution and collection of data as per users' convenience.

7.5.5. Step 5: Analyzing data

This step involves analyzing and interpreting the data collected through the technique employed in the previous step. Again this analysis can be done at the library or can take the help of an external consultant. The data collected should be analyzed in a way to fulfils the objective of the study.

7.5.6. Step 6: Reporting

After analyzing and interpreting the results of the data collected, it may be reported in report form so that the outcome of the result can be applied or implemented for the improvement of the library or its services. It should consider including the following elements:

- A summary of the analysis and interpretation.
- Identification of the barriers, gaps and opportunities
- Steps to eradicate barriers, gaps and possibilities to achieve opportunities.
- Setting short-term and longer-term goals
- How progress will be monitored and evaluated. Apart from the above consideration, the report should contain important suggestions and a conclusion.

7.6. SUMMARY

Though valuing users' opinions and suggestions come under the purview of every library, this can be done by using a variety of methods and techniques of user studies. It is in practice that libraries are using the experiences of users to identify their expectations. Apart from the traditional methods and techniques of user studies are also being utilized by the libraries and information centres. Because the traditional methods are not able to satisfy or fulfilled the library's objectives of user studies. In that case, the methods given in this module can be supplemented or utilized to conduct users' studies.

7.7. MCQ QUESTIONS

1. Use studies in libraries is should be performed A. Regularly B. Not required C. As and when required D. None of the Above

2. Use studies are conducted in libraries for A. Planning B. forecasting C. Examining D. All the above

3. is an important tool to collect empirical data in the social survey:- A. Field Study B. Observations C. Investigation D. Questionnaire

4. Interview method can be used to gather information about A. General B. Greater depth C. Simple D. Complicated

5. Which method keeps the records of users' activities? A. Questionnaire B. Field Study C. Survey D. Diary Method

6. extends the facility to examine activities, behaviour and physical aspect without the permission of participants A. Questionnaire B. Field Study C. Observations D. Diary Method

7. The latest tool in the field of users study. A. Questionnaire B. Field Study C. Observations D. Computer feedback

8. Analysis of information about Personal Details of the Users, Academic Status of the Users, Subject Interest, Circulation Records, Reference Queries, Searching Behaviour of Users, Interlibrary Loan Records, Use of Reading Material, Use of Services/types of equipment, Acquisition Behaviour etc can be utilized in A. Computer feedback B. Analysis of Computer Records C. Internet Browsing Pattern D. Citation Analysis

9. Internet facilities of the library to the users could be examined through: A. Computer feedback B. Analysis of Computer Records C. Internet Browsing Pattern D. Citation Analysis

10. Citation Analysis is an indirect method of use study which analyzes. A. References and bibliographies B. Analysis of Computer Records C. Internet Browsing Pattern D. Citation Analysis

11. A user's need _________ A. Periodical B. Reading Material C. Information D. Books

12. Computer Feedback is a _______ A. Conventional Method B. Indirect methods C. Unconventional Method D. None of the above.

13. Face-to-face interaction involved with users in ________A. Questionnaire B. Interview C. Survey D. Field Study

14. The best indirect method in the present scenario is A. Computer Feedback B. Analysis of Computer Records C. Periodical Information D. None of these

15. "Use" is a reason and "__________" is the main element of system A. Information. B. Books C. Reading Material D. User.

16. Functional Analysis can be done in the form of A. Structured and Unstructured B. Informed and Uninformed Consent C. Formal and Informal D. None of the above

17. In which type of user study research scholar has to put himself in the position of the to observe or examine problem A. Functional Analysis B. Empathic Modelling C. Scenario-based Design D. Cognitive Walkthrough

18. Which method is a cross-sectional study? A. Field Study B. Observations C. Investigation D. Longitudinal study

19. ____________ is a participatory and interactive design. A. Functional Analysis B. Empathic Modelling C Longitudinal study.

20. Which method involves group interview or group discussion? A. Questionnaire B. Focus Group C. Survey D. Diary Method

7.8. SHORT QUESTIONS

What are the methods of user studies?

What are the different types of users?

How do you plan a user study?

What is Empathic Modelling?

What is the basic usability of the Heuristic method?

7.9. LONG QUESTIONS

What are the methods of user studies in library science?

What are the three types of longitudinal studies?

Mention the components of user education.

KEYWORDS: Heuristic method; User education; Empathic Modelling

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UNIT 8

USER EDUCATION: CONCEPT AND NEED

8.0. OBJECTIVES

- Library Orientation

- Users and their characteristics and needs

8.1. OUTCOME OF LEARNING

- To understand the concept of User Education.
- To know the need for User Education.

8.2. STRUCTURE OF UNIT

- Introduction
- Origin and definitions of User Education
- Components or levels of User education
- Aims and Objectives of User Education
- Need for User Education
- Summary
- References

8.3. INTRODUCTION

Education is a lifelong process. User education means educating users on the use of library resources, activities and services. It means educating the users or helping them to make the best use of the library. When a user comes to the library for the first time, he or she does not know about different kinds of resources, activities and services of a particular library. User education gives an introduction to them.

In this age of information and computer, libraries are adopting newly emerging technologies and changing their ways of rendering services to the users. In this changing environment, users require specific training in the use of library services. So, user education may be defined as a process or programme through which users are motivated to use information resources and different kinds of library services. They need assistance and guidance in form of instruction, initiation and education to know how to use library resources and services as the collection of libraries is very complicated nowadays.

There is an old Chinese proverb: "Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime." If you train users, on how to select, locate and retrieve information, certainly you helped them for a lifetime.

8.4. ORIGIN AND DEFINITIONS OF USER EDUCATION

The origins of library user education can be traced back more than 170 years. The earliest evidence of instruction-a librarian lecturing to undergraduates-was found at Harvard College in the 1820s. Most early academic librarians were professors with part-time library appointments who taught the use of libraries for academic purposes. Library lectures were the chosen form of instruction by such institutions as Harvard, Indiana University, and Columbia. Separate courses were implemented in the late 1800s by Ray Davis at the University of Michigan, Oberlin College, and others.
In 1971, the term "bibliographic instruction" originated with the creation of the Association of College and Research Libraries (ACRL) Ad Hoc Committee on Bibliographic Instruction. This was followed in 1973 by the establishment of the Library Orientation Exchange (LOEX), a clearinghouse for materials used in library instruction. In the mid-seventies, the American Library Association's Library Instruction Round Table (LIRT) came into being. Its mission is "to advocate library instruction as a means for developing competent library and

information access skills, along with their use, as a part of lifelong learning.” Unlike ACRL, it represents all types of libraries, academic, public, school, and special. In the last few years a new term has emerged, “information literacy,” and it seems destined to supplant bibliographic instruction as the catchphrase for library instruction.

There are so many definitions of User Education available. Some are as follows:

Fleming (1990) defines user education “as various programmes of instruction, education and exploration provided by libraries to users to enable them to make more effective, efficient and independent use of information sources and services to which these libraries provide access”.

Mews (1972) defines this as instruction given to help the users to make the best use of the library.

Nancy (1984) defines - “User Education is concerned with the library whole information and communication process and one part of this involves the total user interaction

Jacques Tocatline (1978) defined `user education to include any effort or programme which will guide and instruct existing and potential users, individually or collectively with the objectives -

- The recognition of their own information needs;
- The formulation of these needs;
- The effective and efficient use of information services; and
- Assessment of these services.

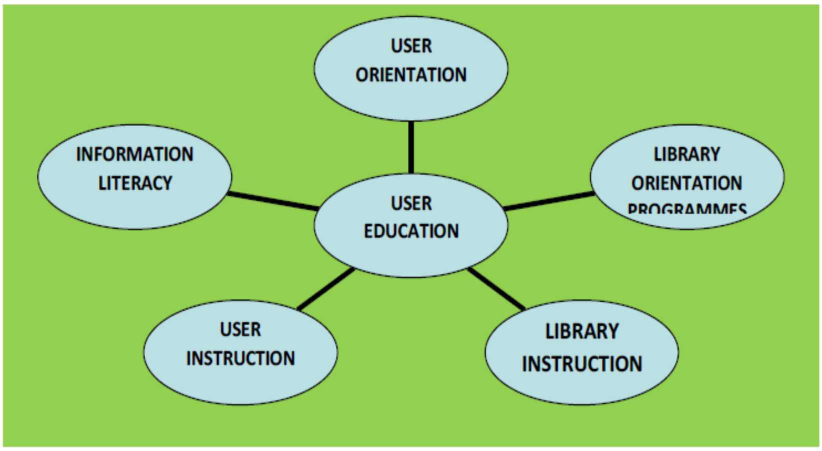
Reitz (2004) has defined User education in the Dictionary of Library and Information Science as “all the activities involved in teaching users how to make the best possible use of library resources, services and facilities, including formal and informal instruction delivered by a librarian or other staff member one-on-one- or in a group. Also includes online tutorials, audio-visual materials and printed guides and pathfinders. A broader term than ‘bibliographic instruction.”

According to **Shahi** “It is a process of activities involved in making the users of the library conscious about the tremendous value of information in day to day life to develop interest among the users to seek information as and when they require” According to **Mishra and Phadke** (1988), User education can be defined as ‘educational potential library users, jointly by the library and academic staff in successive stages to help them to make the best use of the library
resources (library collection and library personnel) and acquire sophisticated knowledge in its use”.

According to **Wikipedia** “Library instruction, also called bibliographic instruction (BI), user education and library orientation, consists of "instructional programs designed to teach library users how to locate the information they need quickly and effectively” Broadly defined, library user education (also called library instruction) teaches users how to make the most effective use of the library system. At Ohio State University (OSU), user education encompasses all activities undertaken to help students become efficient users of information--i.e., how to identify the information need and then how to find, evaluate, and select the best information to meet that need.

Activities to achieve that goal include orientation sessions, workshops, handouts, and course-related and course-integrated instruction. The term "library user education" has more recently been broadened to include the concept of information literacy.

All these definitions focused on strengthening or empowering the library user to get his / her required information. The synonyms of user education are user orientation, library orientation programme, library instruction, user instruction, and information literacy are all one and the same. Orientation is a process of familiarizing the library to library users. Library users should have very good knowledge about the library to retrieve the information and make use of the library services and facilities effectively.



8.5. COMPONENTS OR LEVELS OF USER EDUCATION

There can be three components or levels of User Education, namely:

- **Library Orientation**
- **Library instruction**
- **Bibliographic instruction**

8.5.1. Library orientation

Library orientation means ways of introducing the users to the general methods of usage and services and to the layout such as building and sections of the libraries, stacking arrangement, rules and regulations and facilities available in a particular library. It means to try and create the right kind of environment for effective communication between users and the library staff and to present an image of the library as a pleasant and friendly institution. Orientation makes users confident in the use of the library. After orientation users feel that the library staff is competent and is always willing to help.

8.5.2. Library instruction

Library instruction means providing specific instruction on how to use and understand specific information sources, information systems, information services and tools. It gives instructions to the users on how to select, get and use specific information resources. Library instructions are concerned with learning to make use of the information resources available in a specific library. It includes techniques in using indexes, catalogue, reference materials and bibliographic tools.

8.5.3. Bibliographic Instruction

These instructions aim to use the bibliographic tools, to provide guidance to understand the features of these tools and their nature of subject coverage. These instructions educate users on how to find materials manually or electronically using online public access catalogues (OPACs) and CD – ROMs. It is concerned with the problems of information retrieval and the techniques of exploiting information resources to the maximum extent.

8.6. AIMS AND OBJECTIVES OF USER EDUCATION

Objectives for library instruction were established as early as 1881 when Otis Hall Robinson called for clarification of instructional goals at the American Library Association conference. He wanted purposeful instruction.; As relevant today as they were a hundred years ago, three important objectives were cited:

- Students need to "develop the art of discrimination" to be able to judge the value of books to develop critical judgment;
- Students need to become independent learners--to teach themselves
- Students need to continue to read and study--to become lifelong learners. (Tucker, 1979)

From these objectives has recently come the idea of information literacy.

The aims and objectives of User Education are as follows:

- To familiarise the users with the library and library resources;
- To introduce the general objectives of the library;
- To establish contact between users and staff;
- To instruct the users on the use of library resources and services;
- To bring awareness or to guide the users about library facilities, collection and services etc.;
- To familiarize the user with the automated library services such as OPAC.
- To identify the user's specific information resources as per their information needs;
- To enhance and improve the user's abilities to select appropriate information sources;
- To train the users in the use of information resources;
- To extract the information from the information system;
- To train the users to exploit the library resources effectively;
- To encourage the users to get the assistance of library professionals;
- To train and develop the skills in the users for independent specific information searching;
- To acquaint them with various national and international information networks and databases.
- To educate the users in CD – ROM database searching as well as online searching.

8.7. NEED FOR USER EDUCATION

With the changes in technology and society, the goals of library user education have been changed from library instruction to information literacy and lifelong learning. At present days, libraries have developed and expanded programs to meet the changing needs of library users. Prominent among these is the library user education program.

There are several reasons for providing User Education. They are as follows:

- **Literature explosion and information explosion –** There is a tremendous increase in volume and variety of publications so it is essential to familiarise the users with these different kinds of information sources. User Education plays an important role in the same.

- **E-Resources –** Now - a – days information is available in electronic formats such as CD – ROM
- databases, online databases, e-journals, e-books etc. and to search the information from these e-resources, it is essential to familiarize the users with them.
- **Automation** – No doubt that the information environment in libraries is changing in India. Now – a day's libraries are automating their activities and service arrangement and thees. The use of ICT is making libraries more advanced. Users feel hesitation when they enter such libraries.
- They require someone to help them, to tell the general arrangement and layout of the library.
- **Variety of Library Services –** Modern libraries are providing a variety of services in this age of information such as literature search services, document delivery services, bibliographic services, current awareness services, selective dissemination of information services etc. Users
- are not aware of the kinds of services provided by modern libraries. User Education is a means in this regard.
- **Multiple Database Searching Techniques** – Information is available in CD – ROM databases
- and online databases these days. A number of searching techniques are available to retrieve the information from these databases and the organisation and arrangement of information in these databases are so difficult and complicated that a user can not extract the required information from these databases without guidance and proper training. User Education makes familiar the users with these databases and also trains them with the searching techniques to retrieve their required information.
- **Internet – The** Internet is a global network of several networks. It is a World Wide Web of interconnected university, business, defence and science networks. It is made up of Local Area Networks (LANs), Metropolitan Area Networks (MANs) and huge wide area networks (WANs) of the whole world. In present days, Internet has become an important tool for researchers, political activists, scientists, journalists, librarians, businessmen etc. for retrieving their required information.

Om Shankar Shekhar Singh (2003) has given common facilities provided by the Internet:

- Access to data stored on remote computers;
- Exchange of electronic mail and other datafiles in a wide area environment;
- Online real-time interaction with other network users;
- Receipt and delivery of electronic publications;
- Participation in electronic media mailing lists and conferences; and
- Access to remote scientific computing equipment such as supercomputers, remote sensing equipment, telescopes and graphic processors.

Users are not aware of the above facilities provided by the Internet and User Education trains the
user in the use of the Internet.

Information System and Information Networking – In present days users may get their information existing in remote areas just sitting in one place through networking. There are various information systems. As per Encyclopaedia Britannica "information system**,** an integrated set of components for collecting, storing, and processing data and for delivering information, knowledge, and digital products. Business firms and other organizations rely on information systems to carry out and manage their operations, interact with their customers and suppliers". An Information system is a combination of hardware, software, infrastructure and trained personnel organized to facilitate planning, control, coordination, and decision-making in an organization. In information technology, a network is a series of points or nodes interconnected by communication paths. Networks can interconnect with other networks and contain subnetworks. Information Network is a supportive system of sharing information and services among individuals and groups having a common interest. User Education is essential to familiarise the users with these facilities.

8.8. SUMMARY

Information technology plays a unique role in storing, managing and retrieving information effectively. In the age of computers, libraries are changing from traditional to digital. Library resources are changing from traditional print resources to electronic and digital resources. Libraries are changing their ways of rendering services to users. Networking and multi-user environments and multimedia have been important development in the field of IT. Libraries are increasing the efficiency and effectiveness of their operations and services in this environment. To familiarise the users with these technologies, User Education is essential. Library user education programs need to support the concept of educating for a lifetime.

8.9. MCQ QUESTIONS

1. Tick the synonym of User Education: A. Library Instruction B. Reference Service C. Bibliographic Service D. Current Awareness Service

2. What is the number of components of User Education: 3

3. Recently the term replaced the term User Education is: A. Library education B. Library instruction C. Information Literacy D. Current Awareness Service

4. Application of Information Technology increased the need and importance of User Education True/False

5. User Education originated in _________ 19th century

6. Internet has no impact on providing User Education in libraries. True/False

7. Library user education programs need to support the concept of educating for a lifetime. True/False

8. Libraries may increase the efficiency and effectiveness of their operations and services with the help of User Education. True/False

9. User Education is essential due to a. E-resources b. Database searching c. Internet d. Variety of services A. a and b are correct B. a, b and c are correct C. b and d are correct D. All are correct

10. To make the best use of the library a. Library orientation is essential b. Library instruction is essential c. Bibliographic instruction is essential d. user education is essential A. a and b are correct B. b and c are correct C. a and c are correct D. All are correct

11. 11. Dervin and Nilan's Sense-making approach was tested among auditors, ________

12. How many stages are there in Ellis's Information Seeking behavior model? ________

13. _________ first introduced the cognitive model of information seeking.

14. _________ is regarded as a founder of the study of information behavior.

15. Leckie et al's (1996) model is based on professionals' information needs and information-seeking behaviour according to their different work roles and associated tasks – Whether the statement is. True/False

16. Krikelas' model is an example of a non-linear one" Whether the statement is. True/False

17. Epistemological beliefs on information seeking were coined by ________ A. T.D. Wilson B. C.W. Hanson C. Ethelene Whitmire D. David Eliss

18. In the context of Information seeking behavious ISP stands for ________

19. Among the following which model is said to bridge the gap between traditional and online information-seeking models? A. Choo's Model B. Elisss Model C. Wilson Model D. Whitmire Model

20. In Meho and Tibbo (2003) how many elements have been adopted from Eliss Model _______

8.10. SHORT QUESTIONS

What is user education?

What are the objectives of User Education?

What is the importance of the Library Tour?

Why user education is necessary for a library?

What are the advantages of user education?

8.11. LONG QUESTIONS

Write down the four methods of user education.

What are the two main components of user education?

KEYWORDS: User education; Methods of user education

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UNIT 9

RECENT TRENDS IN USER EDUCATION

9.0. OBJECTIVES

- Some ideas about Library Use
- Library User and User Studies

9.1. OUTCOME OF LEARNING

- To know some ideas about user education
- To know the need for User Education
- To Know Objectives of User Education
- To understand the recent trends in User Education

9.2. STRUCTURE OF UNIT

- Introduction
- What is User Education?
- Needs of User Education
- Objectives of the User Education
- Methods of User Education
- Trends in User Education
- Recent Developments in User Education
- Summary
- References

9.3. INTRODUCTION

The user is the prime component of any information system or library. Due to new emerging information and communication technologies number of e-resource journals are being published Users are not familiar with these newly emerging information resources because they are increasing in leaps and bound. Traditional user education methods are not very much effective. To ensure optimum use of e- information resources, it is necessary to know about the reading habits, information-seeking behaviour, working environment etc. The optimum use of library resources depends entirely upon its educated user. In a changing environment of a digital library, networked environment and fast-growing ICT, it becomes necessary to educate the user to use the modern digital library and e-information resources.

9.4. WHAT IS USER EDUCATION?

The term User Education, User Instruction, User Orientation and User Assistance are synonymous and have been often used interchangeably. The aim of the User Orientation Programme is to introduce users to finding information in a specific library. ALA Glossary of Library and Information Science defines user education as "The term encompasses all types of activities designed to teach users about library services, facilities, organization, library resources and search strategy. It includes instruction in the use of one or more reference sources as a part of reference transactions, library use presentation and bibliographic instruction".

9.5. NEEDS FOR USER EDUCATION

Following are the needs for user education:

- Due to information explosion, users and researchers are unable to keep abreast of current information.

- Due to fast-growing publications in the field of science and technology.
- Due to the increasing use of online information resources and e-publications.
- To make use of library resources independently by the users.
- To familiarize users with the library and new library resources.
- To ensure optimum use of library resources.
- To raise the academic level of the students.
- To develop awareness among users for the use of the library.
- Due to changing behavior of users with the changing environment in the library.
- Due to many users are not aware of how to approach library staff with their problems.

9.6. OBJECTIVES OF THE USER EDUCATION

Following are the objectives of the User Education Programme:

- A general orientation to available facilities and resources.
- To educate the user to know various reference tools in each discipline;
- To create awareness and understanding of the basic relevant library and information sources and services;
- To bridge the gap between the potential user and the library collection;
- To enhance users' skills to select the right information sources and systems for a given information need;
- To facilitate effective and efficient use of the library and its resources;
- To increase users' efficiency and make them able to access, analyze and retrieve the required information;
- To evaluate existing library and information resources on the basis of use; and
- To ensure optimum use of library and information resources

9.7. METHODS OF USER EDUCATION

Following are the methods of the User Education Programme:

- Lecture
- Seminars/workshops
- Tutorials/Demonstration
- Library tour
- Practical exercise
- Individual help
- Audio /Visual Instructions
- Printed media
- Computer-Aided Instructions
- Online help
- OPAC
- Short Term training courses
- Web-based training, etc

9.8. TRENDS IN USER EDUCATION

User is an important component of library and information centres. Modern libraries are going to become knowledge resource centres, and learning centres and trying to fulfil the information needs of the user. There is a need to educate the user to make them able to select, analyze, and retrieve the information according to their needs. In a changing environment, information-seeking behavior, information needs of the users, fast-growing and changing

ICT, availability of e- information resources in a variety of formats, and web-based resources are challenging not only users but also library and information centres.

In the absence of any user education policy, the use of library reading material may be affected. Traditional methods of user education such as manual catalogue lectures and seminars, printed media etc. are becoming obsolete. There is an urgent need to develop user education policy as well as user education methods up to the end user at a global level instead of on library campuses.

With the development of modern digital libraries and e-resources, new user education methods
are necessary. Following are the recent trends in user education:

9.8.1. User education in Networked Environment

Computer networks are growing rapidly around the world. The volume of information available on these networks is also increasing very fast. Tremendously growing computers and communication technologies are challenging library professionals to respond to these and become a part of the mainstream in the library and information profession.

With the fast developing computer network and communication technologies, efforts of networking in various countries got a great boost in implementing operations of national and international computer networks. In the past, networks were mainly used for commercial purposes, but in recent years libraries and information centers have started the use networks for resource sharing.

In a networked environment, the user should be able to use e-library resources available on various
library and information centres. Internet-based resources are increasingly used for scholarly purposes. However, the details regarding scholars’ use of the resources are still unclear when they use e-resources for research. Following are some important electronic resources:

- Electronic journals
- Bulletin Board for Libraries, U K
- Directory of scholarly electronic conferences
- Directory of electronic journals and newsletters
- Online catalogue
- OPAC on Internet
- Online databases
- Electronic Books

9.8.2. Trends in User Education in Digital Libraries

The information flow is becoming larger nowadays. Library provides its user’s documents in both printed and electronic sources such as digitized documents, e-books, e-journals and open repositories. Apart from accessing these resources users have become interested in using open
Internet and search engines.

- **Information Literacy Training for Research Scholars**

This will help the users in the following:

- To understand the author’s rights and IPR
- Deep Knowledge about open access publishing and self-archiving

- Research Assessment with the help of bibliometric methods

- **Tracing Research Information**

The purpose of tracing research information is:

- To know standard characteristics of scholarly literature
- To conduct effective advanced searching through the use of databases
- To evaluate and manage search hits
- To manage ethical use of references in work

9.8.3. Online User Education

Especially in Digital libraries user education may be offered in several ways, such as on-campus instruction classes, one-on-one instruction, Library basic training online courses and research help guides etc.

- **On- campus Instruction classes**

These instruction classes are designed in such a way as to provide the students with practical knowledge of research techniques and help them become independent library users. However, face-to-face teaching may be required for the specific course and research assignments and where the specific need arises by the user and faculty.

- **One-on- one instruction**

This includes databases, online catalogues, and research methods. For a customized research strategy, the user can receive instructions from the research desk.

- **On-line Course on Basic Library Training**

Online course for basic library training is designed in such a way to provide users with library instructions facilities similar to face-to-face classroom instructions. The online course provides user services available and how to use library resources and databases etc.

- **Research Help Guides**

This is designed to facilitate help in specific needs. Research Help Guide recommends databases, journals, books, and web pages and finding specific information, assignments or a general topic or a specific topic.

- **Library Tour**

Library tour videos should be designed to familiarize students and users with the physical layout of the library including study locations and to introduce them to the resources and services of the library.

9.9. ONLINE PUBLIC ACCESS CATALOGUE

A library catalogue is the most important tool for locating reading material in the library. Recently its value has been restricted by its physical form, most commonly a large card catalogue or a set of printed volumes. The advent of computers and ICT, with their ability to process large amounts of information and output in a variety of formats, has finally brought the library to the customer, in the form of an Online Public Access Catalogue (OPAC). OPAC provides access to the catalogue through a computer terminal. OPAC allows searching the entire catalogue online, conveniently and quickly, using one or more search criteria. One can, for example, search by author, title, keywords, class number or one or more of these combined together. OPAC even shows the current status of a book, whether it is loaned out, available on the shelf or lying elsewhere. Another advantage of OPAC is its ability to display catalogue records in a variety of formats such as *AACR2*, *MARC* etc, and the records can be displayed in the desired order. For example, one can display records arranged (sorted) by author, title or call number. Most library management software packages offer printing of bibliographies from OPAC either on a printer or on a file. An OPAC terminal should be equipped with search software, which is usually part of integrated library management systems such as *LibSys, EasyLib, NewGenLib, SOUL*, *Sanjay* etc. Some integrated library management packages even use OPAC for other user services like reservation, membership enquiry and registration, inter-library loans etc. When OPAC is accessible via the Internet it is termed Web OPAC. It is accessible by remote users as well as on-campus via the intranet. OPAC provides valuable information to the library users and he/she may be able to know the following information:

- Collection of the library
- Sorting of records by author, title or subject
- Searching for records
- Some ideas about the library
- Academic calendar of the institution

Now OPAC is using more sophisticated technologies and the system is more users centred. Tagging, reviewing and RSS feeds are made available to users for interaction.

9.10. INFORMATION LITERACY EDUCATION

Information Literacy is a kind of competency which refers to the ability to use information, study, analysis, search and retrieve information by the user. Information literacy is essential for survival in the information society. Information literacy education mainly includes education about information awareness and information capacity. Information Literacy includes:

- Information Awareness
- Sensitivity of information
- Capturing of information
- Analysis and absorption of information
- Access to Information Awareness
- Information need awareness
- Information limitation awareness
- Information in advance awareness
- Information innovation awareness
- Ability to create new information

The increased information capacity of users to use information efficiently is becoming necessary for user education. Therefore the ability of the user's information capacity is a key aspect of user education. Various national and international organizations, such as UNESCO, IFLA, ALA, CILIP, ILA, IASLIC etc., are playing a pivotal role in the promotion of Information Literacy among the masses.

9.10.1. Information Technology Education

With the development of information society, computer technology and the development of information technology have become important tools and means in information retrieval and exchange. Multimedia technology, CD-ROM technology, database technology, storage and network technology provide great conveniences for our information storage, extraction, development and exploration, as well as increasing users' dependence on technology. A library should allow users to master the use of network functions and methods; learn how to use foreign language bibliographic databases in the collection and inquiry system of thematic literature database; learn the use of electronic document collections as well as internet information resources. There is a need to provide information technology education to library users to improve their information competency.

9.10.2. Introducing Literature Retrieval Courses in Colleges and Universities

Seeking information is a complex information and communication activity requiring access to diverse sources of information to deal with personal, social, and work-related problems. The tremendous development of information technology, the growth of the Internet, and the accompanying development of information and communication services provide users with access to many new services and potential new channels of information access. Generally setting up ***Document Retrieval and Utilization*** course in colleges and universities has become a major route for library user education.

Information retrieval course is the backbone of the higher education curriculum as well as library and information science education, and also should become a required course for college and university students. In the Indian context Opening an information retrieval course allows users to grasp a variety of search theories, methods, strategies and technologies, providing the basic knowledge of the use of the library. Current information retrieval courses should be based on user-centred teaching and learning activities, fully encourage students' potential and learning initiative and make use of advanced teaching techniques.

9.10.3. Web-Based Information Literacy Education

Many libraries such as Bengaluru University, Indian Institute of Science, Jaypee University of Information and Technology and Indian Institute of Information Technology have established their own web page, which generally includes the main overview of the library, services introduction, web navigation and user training. Through these, the users can have a more complete and systematic understanding of the library. At the same time, they can make full use of collection resources through it and enjoy the various services. Online information literacy education is web-based information literacy education, which makes full use of computer and network technologies. It is in terms of traditional library users and becomes a trend in library user education. To develop the depth and expansion of library user education and make the library close to readers, introducing the e-mail, BBS forum, videoconference and even online chat to library user education will be effective methods. At the same time, the use of sophisticated digital video technology counselling programs can also help improve the skills of user information and retrieval of complex issues.

9.10.4. Through Library Portals

A **library portal** is an interface to access library resources and services through a single access and management point for users] combining the circulation and catalog functions of an integrated library system (ILS) with additional tools and facilities. The Library Portal is a good place to start learning about the library and its services. The ideal library portal then will have the most thorough coverage possible in several areas of the library profession, for all types of libraries.

- Professional resources, such as practice manuals, standards, model programs, reports, and Studies
- Originations, from the large national associations to local and special interest groups
- Publications, both print and electronic materials
- Conferences and other events to be organized
- Library Web sites, including Web catalogs, Web OPACs
- Communication channels, like discussion lists
- Job announcements
- Library user guidance
- Reference Tools

- **Users/Clients and Portals**

The basic idea behind the creation of the portal is to simplify access to resources with minimum help from others. The library portal should user friendly. Users/Clients need automatic access to resources of their library from one and only one place that is referred to the portal. Having some features like customization for clarity, simplicity of use, self-evident links and readily information retrieval and flexibility of personalization options the portal help the users/clients as follow:

- Save the time and anxiety of finding information
- Increase the self-confidence in the information search process
- Aware of current updates in their field. e.g. Article Alert (List of articles that appeared recently
- Periodicals),
- New Arrivals (List of new books added to the library)
- National and international institutes etc.
- Access Restricted users (Faculty) can access, and download their required information from anywhere.
- How to use the library
- Library user advisory service
- How to use reference and information sources

The Jaypee University of Information Technology maintains such kind of portal named as Learning Resource Centre (http://www.juit.ac.in/library)

9.11. RECENT DEVELOPMENTS IN USER EDUCATION

The development of online libraries, marketing of library services, products and communication with the user about the library, library services, products, and collection of library materials through multimedia becoming relevant today. With the emergence of various generations, web technologies libraries are accessible 24X 7 to their users through different tools and various platforms for video creation and sharing.

According to Pew Internet Research Project (2011), 71 % of American people have watched a video or shared videos on YouTube. Libraries can put their content on websites for users. However, it requires a commitment to put videos and update content regularly for sharing with its users.

The followings are the multimedia-based user education methods:

9.11.1. Selection of Library Services

Selection of library services is an important task. Such as

- Demonstration of circulation section Demonstration of reference service
- Demonstration of 24X7accessibility of online journals
- Demonstration of layout of the library
- Demonstration of reprographic section
- Document delivery services

So, multimedia videos may be prepared for the promotion and benefit of the users

9.11.2. Creation of PowerPoint Presentation

The promotion of library activities may be done through MS PowerPoint presentations highlighting important library activities. Demonstration through MS PowerPoint becomes interactive due to voice and animation effects.

9.11.3. Uploading videos on YouTube

Once the videos are ready highlight important activities, sections, library layout and library collection etc. These videos may be uploaded on YouTube, where a channel may be created in the name of a library or learning resource centre. The British Library UK uploaded several videos on YouTube Such as using the Reading Room, Exploring the Collections and Document Supply Centre: Registration etc.

9.11.4. Library user education through Social Networking Sites

Social Networking sites influence the entire society as well as various organizations including libraries. Facebook, LinkedIn etc. have been dominating our lives. Numbers of libraries are being placed on Facebook. Library users may comment on the library page. Comments may be divided into several categories which may be related to the library or not related to the library.

Comments Related to Library	**Comments not Related to Library**
General Information and layout of the Library	General comments
Services of the Library	Friendship
Complaints and suggestions	Other services
Reference Desk/May I Help You	News and Bulletin
Library working hours	Other Comments
Thanks	
Reference questions	
Bookmarking	

Today user is sharing information through social media and this trend is proliferating day by day. Libraries are also taking the benefit of social media to interact with their users.

9.12. SUMMARY

Library user is an important component of an information system and library. A number of libraries are going towards digitization. In a digital and networked environment, users' information need is changing. Libraries have the challenge to provide the *right information to the right user at the right time.* There is a need to educate library users in a changing environment for optimum use of library information resources. It has been observed that most of the users do not want to come to the library. Most users use search engines like Google and yahoo for searching for information. But users don't get pinpointed information. There is a problem with the authenticity, and relevancy of information retrieved from search engines. Library or information centres help users to find their information with authenticity, relevancy and pin pointedly. Various methods are used to educate library users. Following are the recent trends in library user education

- Web-based Information Literacy Education
- Library user education through Social Networking Sites
- Uploading videos on YouTube
- Users/Clients and Portal
- Through Library Portal

Libraries should adopt user education methods according to the changing needs.

9.13. MCQ QUESTIONS

1. A general orientation to available facilities and resources of the library refers to A. User Education B. Reference Service C. Reference questions D. Information retrieval

2. Library Portal facilitates A. Library Science Education B. Circulation of Reading materials C. Cataloguing D. Library User Guidance

3. Library user advisory service is associated with A. Reference questions B. Bookmarking C. User Orientation D. None of the Above

4. UNESCO promotes A. Information Literacy B. Web Cataloguing C. User Education D. None of the Above

5. Demonstration of the layout of the library is associated with A. OPAC B. Multimedia-based User Education C. Reference Tools D. Model programs

6. Online information literacy education is a A. Web-based information literacy education B. Multimedia based User Education C. Document Delivery Service D. Web OPAC

7. Information Literacy is a kind of A. Competency B. User awareness C. Information capacity D. User Assistance

8. Uploading library activities videos on YouTube is A. multimedia-based user education B. automatic access of resources C. Information awareness D. Practice manuals

9. Information awareness refers to A. Information Retrieval B. Information capacity C. Information Technology Education D. Information literacy

10. Library Portal display A. Job announcements B. Library user guidance C. Reference Tools D. All of the above

5. Which of the following is not a type of proximity searching: A. Word B. Sentence C. Paragraph D. Full Text

6. ________ is used for Truncation searching.

7. Search strategy' is not similar to 'search tactic'. False/True

8. Web information science research mostly concentrates on developing sophisticated search tools and technologies. True

9. XOR stands for ________ A. exclusive B. excluding C. extending D. expressiveness

10. ________ is the foremost agriculture literature / biomedical literature database of medicine. biomedical literature

11. Boolean logic is a logical relationship of search terms. It is named after the British / American mathematician George Boole (1815-64). _______

12. Kuhlthaus's model was first reported in the year: ______

13. According to Robert Taylor's model how many levels are there in information seeking process? ______

14. Who first mentioned that "sources preference and use patterns of information are ultimately socially conditioned"? A. Gloria Leckie B. Robert Taylor C. Reijo Savolainen D. none of the above

15. Sense-making model was given by: A. Wilson B. Eliss C. Choo D. Dervin

16. In which model 'role-related barriers' in information seeking first identified? A. Wilson-Eliss Mix Model B. Eliss Model C. Kuhlthaus's model D. Bloms Model

17. What is the last stage of Kuhlthous Model information-seeking behavior: A. Selection B. Exploration C. Presentation/Assessment D. Formation

18. The outcome of the information-seeking process is A. Wisdom B. Data C. Information D. utilization

19. Who defined information behavior as the 'totality of human behavior in relation to resources and channels of information A. Wilson B. Ellis C. Ikoja D. Wright&Guy

20. Kuhlthau's Information Search Process (ISP) Model was tested among ________students

9.14. SHORT QUESTIONS

What are the methods of user education?

What is the importance of user education?

What are the advantages of user education?

What is information literacy explained?

What are the current changes in education?

9.15. LONG QUESTIONS

What exactly is information literacy and what role does it play in education?

What is an OPAC and how is it used in libraries?

What are the two main components of user education?

KEYWORDS: User education; Information literacy; Importance user education

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UNIT 10

INFORMATION SEEKING BEHAVIOR: CONCEPT AND METHODS

10.0. OBJECTIVES

- Ideas about information
- Need and seeking behaviour

10.1. OUTCOME OF LEARNING

- To understand the Concept of Information Seeking Behavior.
- To know the various methods of Information Seeking Behavior

10.2. STRUCTURE OF UNIT

- Introduction
- Meaning of Key Terms
- Background of the Concept
- Importance of Information Seeking Behaviour
- Phases of Information Seeking
- Methods of Information Seeking Behaviour
- Summary
- References

10.3. INTRODUCTION

Libraries are essential in bridging the gaps that information seekers from various backgrounds may have. They are seen as the gatekeepers of access to knowledge and are liable for disseminating it to fulfil information needs. They can provide the necessary access to all of the information from both within and outside an information seeker's field. Through the years people of all professions have been searching for information needed for various reasons. In the past, this has been done through books, magazines, journals, conferences and meetings to mention a few sources. The current information environment is rich, characterized by a proliferation of information sources and providers, a multiplicity of methods for accessing information and redundancy of content from multiple sources. In this "overloaded" information environment, many information users tend to experience a sense of information
inadequacy and anxiety. In this complex information environment, insight into information seeking can be gained by understanding - how users seek information sources and how they choose content to meet their needs.

10.4. MEANING OF KEY TERMS

The definitions of key or important terms are given below:

Information: Information comes from in-forming, conforming, forming in our mind, things received externally by impact or stimulus. These have to be given shape and be understood in any form they should appear. It can be any difference you perceive in your environment or within yourself.

Information need: An information need is a recognition that [one's] knowledge is inadequate to satisfy a goal (Case, 2007) or an "uncertainty" (Kuhlthau, 1991). An information need evolves from an awareness of something missing, which necessitates the seeking of information that might contribute to understanding and meaning

Information Behaviour: According to Wilson (2000), "Information Behavior is the totality of human behavior in relation to sources and channels of information, including both active and passive information seeking and information use".

Information Seeking: Case (2007) "a conscious effort to acquire information in response to a need or gap in your knowledge". Thus, Information seeking is the process engaged in by humans to change their state of knowledge. It is a high-level cognitive process that is part of learning or problem-solving. To seek information implies the need to change the state of one's knowledge.

Information-Seeking Behaviour: Begins when someone realizes the existence of an information need and ends when that need is believed to have been satisfied. The type of information, people search for is situational in that it depends on a need that is linked to a given time and place. (Krikelas, 1983). The seeker turns to formal and informal sources of information and is ultimately satisfied or dissatisfied with the end result (Wilson, 1999). How information is gathered in personal, academic or work environments and the resources used.
http://www.definitions.net/definition/information%20seeking%20behavior

Information Searching Behaviour: Information Searching Behaviour is the 'micro-level' of behaviour employed by the searcher in interacting with information systems of all kinds.

Information Use Behaviour: Information use behaviour consists of the physical and mental acts involved in incorporating the information found into the person's existing knowledge base.

10.5. BACKGROUND OF THE CONCEPT

The concept of "information behaviour" was coined in the late 1990s and is closely related and often not precisely defined to the concept of user studies, use studies, information-need studies,
information transfer studies, communication behaviour studies, information dissemination and
utilization studies, user research etc. The term "information seeking research" was used to include all kinds of research on people's interaction with information. Until the 1980s, most of the studies were concerned with system-based rather than user-based and since the 1980s, studies shift towards a person-centred approach, accompanied by a switch from quantitative methods to qualitative methods. Recently, user studies were more and more a well-defined area in information science. Information-seeking behaviour in digital and web environments attracted more sight. However, some researchers came to feel that "information seeking" suggested only explicit efforts to locate information and did not include the many other ways people and information interacted.

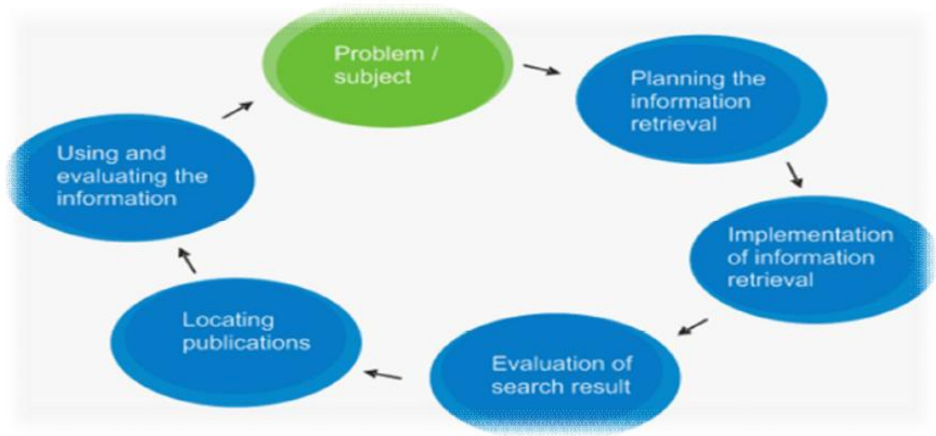
10.6. IMPORTANCE OF INFORMATION-SEEKING BEHAVIOUR

Information-seeking behaviour has been a focus of research within the library and information profession. Understanding human information behaviour is a vital component in providing high-quality library service. When LIS professionals understand human information-seeking behaviours and preferences, they can transform their services and resources to correspond to these patterns, to better serve users' information needs. People from all walks of life seek out and utilize information every day. Information regarding studies and research, work, entertainment, health, money matters, family and other topics, is obtained from various sources. Knowledge of reasons and motivation - why people seek information and the types of information they seek in their everyday lives can impact "collection development, reference services, programming, and budget allotment practices" (Agosto and Hughes-Hassell, 2005). Students navigating their academic and everyday life may face more problems. This has to do with their ability to access the most relevant information when they need it and knowing what information they need to make their decisions in a different culture. Traditionally, a lot of orientation programmes tend to be provided from all around the world with different information needs, so catering to each person's need is very difficult (Mori, 2000).

Therefore, it would seem that understanding Information Seeking Behaviour is of interest because it can inform educational institutions on how best to provide information to students. More importantly, this could help institutions to understand how to help students to improve and develop their Information Seeking Behaviour and to find the most relevant information as they navigate a new complex environment in a timely manner.

10.7. PHASES OF INFORMATION SEEKING

An information search can be described as a process (see image below) with different stages. During the process, you will consider and define the problem area, using many different information sources, information-seeking methods and library services (www.helsinki.fi/tvtajokortti/english/)



The following list gives more details about the different stages in the process:

a. **Problem/Subject:** the information need arises when you need to find information to solve a problem.
b. **Planning the information retrieval:** define the information need, select information sources, search methods and search words.
c. **Implementation of information retrieval**: execute the planned information retrieval (information-retrieval methods).

d. **Evaluation of the search result:** evaluate the results of the information retrieval (number of references and their accuracy).
e. **Locating publications:** find out where the publication (e.g. an article) is located.
f. **Using and evaluating the information:** evaluate the final result (source criticism and research ethics).

10.8. METHODS OF INFORMATION-SEEKING BEHAVIOUR

It is important to understand that some methods of information seeking are sought out, or chosen by the seeker. The number of ways, the users' studies can be conducted to identify what exactly users want from the library. Information user studies over the years have attempted to explain information behaviour, use phenomena, and understand information use behaviour, to predict this to control and improve information use by manipulating essential conditions. One of the preliminaries to the attainment of this objective is the description of user behaviour in many aspects (Ford, 1977). There are many user research methods that one can use and there are even more variations and names for them. But regardless of what name they're given, methods should be chosen that is suitable for the situation at hand. The methods used so far may be broken down into two main categories, i.e. (a) Direct Methods - where the researcher does very much interact with users and Indirect Methods - where the researcher does not actually interact with users.

(a) Direct Methods

Interview Method: Interviews done with actual users are the mainstay of user research. In this method, the interviewer asks questions when he comes into face-to-face contact with the other person or persons. You can have a set of questions asked in a particular order called "structured" interviews or you could keep it completely open called "unstructured" in which, there is no fixed order of questions. Interviews are used to collect self-reported experiences, opinions, preferences and behavioural motivations. Interviews are often carried out after a test session to gather user opinions, such as the user's satisfaction with the system and can also be used in the interpretative evaluation. This method is more time-consuming especially when the sample is large and involved higher costs for selecting, training and supervising interviews.

Observation Method: Observation is one of the important methods which enables to study of the behaviour of individuals as it occurs. User observation is aimed at learning from the direct or indirect observations of users (such as video recording) in the context of real usage by interviewing and observing users at work while doing their own work. Systematic observation, wan be defined as a particular approach to quantifying behaviour. This approach is typically concerned with naturally occurring behaviour observed in a real context. These methods are most reliable and precise but they are also very expensive.

Focus Group: They are good for idea generation, brainstorming, and comparing alternative designs. A Focus group is a structured discussion about specific topics moderated by a trained group leader. A typical focus group session includes from 8 to 12 people and lasts for two hours. The people are carefully chosen to represent the potential users of the product. If the potential audience is large, several focus group sessions can be performed. Focus groups are excellent ways to probe users' attitudes, beliefs and desires. They do not provide information about what users actually do. For that reason, they can be used before system implementation, and during the requirement analysis phase. Depending on the kind of user involved (e.g. final users or domain experts) they can be utilized to gather functional requirements, data requirements, usability requirements and environmental requirements.

Focus groups can also be used in the interpretative evaluation. A focus group should be expected to generate a lot of useful information and ideas. It is suited for use at the early stages of design, but can (and should) be used during the whole process.

Scenario-based Design: A method used to describe existing activities or to foresee new activities. A scenario is aimed at illustrating a usage situation by showing the user's actions step by step. It can be represented by textual descriptions, images, and videos and it can be employed in different design phases. Scenarios are stories which show the future. A scenario moves from the past to the future showing how things work and how people's behaviour and preferences change. Scenarios help us to look at the technology in a context, and the invention of specific characters for the scenarios keeps us connected to a range of users and preferences. A scenario makes us think about many levels of interaction at once including information about the environment, person, and details of screen and input devices as well as other objects and activities happening.

(b) Indirect Methods

Questionnaires and Survey Method: Technically, questionnaires are self-reported (and thus indirect) whereas surveys are conducted by the researcher (and thus direct contact), but the terms are often used interchangeably. Most user research tends to use the self-reported form, wherein both the questions and the answers are fixed. Through this method, we study large and small populations by selecting and studying samples chosen from the defined population. Questions in a questionnaire can be either open-ended or closed-ended. In a closed-ended question, respondents are offered a set of answers from which they are asked to choose the one that most closely represents their views. In the case of open-ended questions, it is not followed by any kind of specified choice and the respondent's answers are recorded in full. The closed-ended questions are easy to ask and can be quickly answered by the respondent. One major disadvantage of this method is that it may introduce bias either by forcing the respondent to choose from given alternatives.

Diary Method: In this method, individuals understudied are asked to keep a detailed record of particular information activities e.g. searching for information, actual reading, discussing with colleagues, library use, etc. for a given period of time. To facilitate the work of recording and the final analysis of data, diary forms are supplied to the users for different activities. It is quite evident that in this method, maximum effort is involved on the part of the users. Diaries provide a firsthand account of the individual's life experiences. Many times the respondents do not record the information item consistently needed in their day-to-day work and can be effective when the population under surveys is necessarily very small. The diary also gives people more time to think about what they feel is important and relate it to the project team. As a diary study explicitly encourages people to look at and think about their lives, it renders them sensitive to the issues in their own context- that may be of relevance for a design project. In fact, diaries are a good means of preparing users for project-related interviews.

Citation Analysis: This method entails the analysis of the bibliographical references that are usually appended with every research communication. Analysis of such citations can reveal useful information like the relative use of different kinds of documents such as books, periodicals, reports, patents etc., the age of these documents which reveal the rate of obsolescence of literature, the most frequently used titles of periodicals, scattering of literature, language preference etc. within different scientific communities according to subjects, nationality, etc. This type of information can be utilized for the acquisition of materials, selection of periodical titles and judicious distribution of library funds and so on.

Analysis of Library Records: Various types of library records have been used by librarians for a long time. Records of reference questions and literature searches can give librarians insight into the operations of a library, the use of various types of documents, the number of documents used per question, number of facets that can be utilized in the design and improvement of library services. Similarly, circulation records can be analyzed to determine the activity of a library as well as to determine the reading habits of library users. A closely related method is the analysis of the personal indexes used by the researchers.

Repertory Grid Analysis: George A. Kelly developed the Repertory Grid Technique (originally The Rep Test) is a very useful method from the field of psychology that can be used to uncover customers' perceptions of products and services and to identify their hidden needs. Customers are asked multiple times to compare and contrast random sets of three products or services which they are familiar with. Each set of three products is presented to them with the same question which is "In your experience, how are two of these products similar to each other and different from the third?" This forces interviewees to think deeply and articulate their views on products or services. The Repertory Grid is an instrument designed to capture the dimensions and structure of personal meaning. Its aim is to describe the ways in which people give meaning to their experiences in their own terms. It is not so much a test in the conventional sense of the word as a structured interview designed to make those constructs with which persons organize their world more explicit. The way in which we get to know and interpret our milieu, our understanding of ourselves and others, is guided by an implicit theory which is the result of conclusions drawn from our experiences. The repertory grid, in its many forms, is a method used to explore the structure and content of these implicit theories/personal meanings through which we perceive and act in our day-to-day existence. For example, Priyanshu may construe Hemu and Ankur as "nice" as opposed to Vipin whom he sees as "distant." The "nice-distant" dimension enables Priyanshu to distinguish between these three people and to give meaning to his experiences with them, not only to interpret their past behaviour but also to predict future possibilities for action in relation to them. The advantages of the repertory grid technique are the ability to determine the relationship between constructs, ease of use and the absence of researcher bias (Boyle, 2005).

Delphi Method: The name "Delphi" was developed by Project RAND during the 1950- the 1960s (1959) by Olaf Helmet, Norman Dalkey, and Nicholas Rescher. Delphi is defined as, "an organized method" for collecting views and information pertaining to a specific area that allows dialogue between geographically separated experts while serving an effective means for learning, gathering a group of experts to forecast events and assess complex issues, collective human intelligence. A process of exploring, assessing and evaluating. It is a structured communication technique, originally developed as a systematic, interactive forecasting method which relies on a panel of experts. The experts answer questionnaires in two or more rounds.

After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. It is believed that during this process the range of the answers will decrease and the group will converge on the "correct" answer. Finally, the process is stopped after a predefined stop criterion (e.g. number of rounds, achievement of consensus and stability of results) and the mean or median scores of the final rounds determine the results.

Computer - Feedback: With the availability and use of computerized information services this technique is now available. Essentially, this method makes use of records obtained as by-products of a computer search. Usually, the technique is used to generate clues for the improvement of search strategies within the limited context of individual computerized systems.

Wikis, blogs and discussion forums: The general idea of wikis, blogs and discussion forums is that anyone having an Internet connection can contribute by posting or editing information, which has already been posted. In this sense, these technologies gather user opinions, experiences and practices of users from all over the world. For this reason, wikis, blogs and discussion forums may be bountiful sources for user requirements or user experience with a particular product or service. **Wikis** are often used to create collaborative websites, to power community websites and for note taking. In business, they are used to provide intranet and knowledge management systems. **Blogs** are usually used to express personal opinions on activities, situations, services and products. **Discussion forums** are used to exchange information and views on a particular topic. Many wiki communities or discussion forums have limited access or require membership. Others, on the contrary, are “open to everyone”. All these technologies relying on remote user participation, user expression and collaborative generation of ideas can be used as a complementary techniques for eliciting requirements. However, wikis, blogs and discussion forums should be used having in mind the following limitations:

- They may express the point of view of a small number of people controlling the interaction (e.g. webmasters, moderators, etc.);
- They provide indirect insight into the users’ experience;
- They are focused on opinions, attitudes and views and may provide limited information about user characteristics, tasks and environment.
- Specialized discussion forums of technologies for people with disabilities may be very useful to get acquainted with a community and to get feedback on existing products from “real” users. These forums may also be useful to gather and promote ideas about inclusive design and design for all.

10.9. SUMMARY

The discussion in this paper aimed to contribute to an enhanced understanding of human information-seeking behaviour and present the various methods of Information Seeking Behaviour. By gaining a fuller understanding of how users of traditional libraries behave and the reading styles of individuals, the knowledge can be applied to enhance a digital library environment. Librarians, users and systems developers alike must cope with the changing and emerging technological environment to adequately respond to user needs. Librarians and information service providers must be careful to address the information need of information seekers. They must avoid generalizing the need and attempting to fulfil it by providing the information seeker with basic information contained within their library.

10.10. MCQ QUESTIONS

1. Information need is defined as uncertainty by: A. Kuhlthau B. Case C. Wilson D. Krikelas

2. conscious effort to acquire information in response to a need or gap in your knowledge is expressed by: A. Wilson B. Case C. Kuhlthau D. None

3. Who said that the seeker turns to formal and informal sources of information and is ultimately satisfied or dissatisfied with the end result? A. Wilson B. Dervin C. Esinberg D. Case

4. A survey design that collects consensus opinions of Panel of Experts and the judgement is known is: A. Interview B. Case Study Method C. Delphi technique D. Historical Method

5. The final product of information generation is: A. Data B. Information C. Knowledge D. Wisdom

6. Who developed Repertory Grid Analysis? A. George A. Kelly B. Olaf Helmet C. Norman Dalkey D. Nicholas Rescher

7. Delphi Method was developed? A. 1959 B. 1955 C. 1960 D. 1961

8. Citation Analysis is one of the Direct Methods of Information Seeking Behaviour: False/True

9. Who said Mingle freely with library users to help them in every way? A. Wilson T.D B. Samuel Green C. Waples. D.D. Weights. W

10. How many stages are identified by Kuhlthau Information seeking behaviour? _________

11. When was the first Royal Society of Scientific Information Conference was held? ________

12. Information behavior studies emphasize on active and passive information seeking and use in different disciplines. _______________

13. Large numbers of ISB studies have been undertaken in humanities and ___________

14. Kuhlthau's ISB model consists of eight stages - a) Initiation, b) Selection, c) Exploration, d) Formulation, e) Collection, f) Presentation, g) Assessment and h) Information transfer. False/True

15. Major portion of the literature on Information Seeking Behavior signifies decision making and problem solving. False/True

16. Wilson’s ISB model has identified two types of demands-demand information system and demand on information sources. False/True

17. Wildcards are: A. allows you to specify how close two (or more) words must be to each other in order to register a match. B. sends searches to several search engines. C. an electronic record is presented as a field. D. characters that are used to assist in searching for information.

18. MeSH stands for : A. The Medical education Subject Headings B. The Medico-legal Subject Headings C. The Medical Subject Headings D. The Meta Subject Headings

19. Which of the following is not a type of proximity searching :A. Word B. Sentence C. Paragraph D. Full Text

20. __________ enable you to narrow your search to a particular discipline and profile websites of particular interest. A. Specialized search engines. B. Natural language engines. C. Meta-search engines. D. Artificial engines

10.11. SHORT QUESTIONS

What do you mean by information-seeking behaviour?

What is an example of information seeking?

What is the characteristic of information seeking?

10.12. LONG QUESTIONS

What are the models of information-seeking behaviour?

Why is it important to study the information user Behaviour model?

What is the six-stage process of information-seeking Behaviour in library and information science?

KEYWORDS: Information-seeking behaviour; characteristic of information seeking; Phases of Information Seeking

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UNIT 11

AN OVERVIEW OF RESEARCH OUTPUT ON USER STUDIES

11.0. OBJECTIVES

- Understand the significance of research on user studies
- Know the role of agencies working on user studies
- Establish the disciplines in which user studies conducted
- Conduct an online survey by using a readymade questionnaire and
- Know the web links on which resources are available for use.

11.1. OUTCOME OF LEARNING

After reading this module, you will be able to:

- Know the concept of user studies.
- Understand the meaning of research output.
- Assess the need and scope of research output on user studies.
- Know the types of research output on user studies.
- Find out the sources available on user studies.
- Gain knowledge on different databases like Jstor etc.
- Conduct an online survey by using a readymade questionnaire.
- Know the web links on which resources are available for use.

11.2. STRUCTURE OF UNIT

- Introduction
- The Concept of User Studies
- Meaning of Research Output
- Need and Scope of Research Output on User Studies
- Types of Research Output on User Studies
- Summary
- References

11.3. INTRODUCTION

The „user studies‟ has now become an important thrust area for research in library and information science because the results of user studies may be used to improve the services and functioning of the libraries. Many research studies have focused on how people use information/electronic resources or on their feelings about electronic and print resources in the library over the years. These usage studies draw conclusions about the behavior and preferences of library users, although sometimes the conclusions are contradictory or unclear. It is quite obvious that the practice of librarianship may be improved by making a valuable user study. We can also enhance the understanding of users‟ behaviour through a user study. The rationale of the study should be taken into mind while conducting user‟ studies. The studies based on the information needs of particular users can also motivate those users for their reading interest in the subject concerned. The study of the behaviour of users will certainly be helpful to promote library activities and practices. Generally, two types of surveys are conducted for research on user studies. First, the libraries themselves, in this survey libraries conduct surveys to evaluate the services and functioning of the library and institutions and then improve the quality of services for users of their library. Another type of users studies is concerned with individuals or other than libraries for making the general policy for particular libraries. The survey can be conducted online or offline. For this, time and effort both are important factors to conduct a user study.

11.4. THE CONCEPT OF USER STUDIES

Generally, we use it to study the user's behaviour and their information needs under the user studies. What we need to know, What information do we need in order to provide good service to the people who come to us to use the concerned library to fulfil their information needs etc. Any study regarding the use of the library and its resources in any form are certain basic issues that come under the category of a user study. We know that user study may consist of multi-dimensional aspects. Keeping in mind the nature of the study we may distinguish the user studies in the following manner.

- Human resources-related studies for all kinds of users‟ interaction with library personnel for the betterment of library services and library resources as well.
- What kind of information resources like books, journals working papers, monographs, and grey literature is being used by the users of the library? Format like digital, e-format or traditional format is more used by users. All studies related to the use of library material may be assessed or studies for the overall development of the concerned library.
- All the studies related to the dissemination of the information available in the library or in other words it may be stated that all studies related to the knowledge dissemination system of the library achieve its goals.

11.5. MEANING OF RESEARCH OUTPUT

According to Concise Oxford Dictionary output means "the amount of something produced by a person, machine or industry" or "the process of producing something" or "the power, energy etc. supplied by a device or system". In general, research output means all the processes of producing research are called research output.

The research outputs, in terms of libraries, are concerned with of the use of library resources to fulfil the objectives of the libraries. It may also consist of the impact of all the devices and techniques, library services, collections, facilities, and views of library personnel and users community.

Research is defined as the creation of new knowledge and/or the use of existing knowledge in a new and creative way to generate new concepts, methodologies and understandings. This could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes.

The major difference between research outputs and research outcomes is that research outputs are activities, events, services, and products that reach people, however, research outcomes or impacts are changes in knowledge, actions, or conditions (http://agsci.oregonstate.edu).

11.6. NEED AND SCOPE OF RESEARCH OUTPUT ON USER STUDIES

The user is an important component of the library system. A large number of studies carried out so far consist of several aspects of the user‟s view regarding library facilities and services and behaviour of library staff towards library users. Most of the user‟s studies carried out so far in India are related to educational research work for a certain purpose. These kinds of studies conducted and various levels in India like universities, colleges and schools in different states. Some of the studies are based on the academic institutions established for the development of science, humanities and social sciences. The scope of these studies is very limited as they were designed for a certain purpose. Only a few have been taken into consideration for publication and policy-making purposes. The concept of internal evaluation of the library system in India is still not very well as desired. Most of the time libraries in which the survey was conducted do not know the output of the survey, as the report of that survey was not submitted to them. These kinds of studies are limited to surveyor and their concerned authority only. The provision was never made that a copy of the report must be sent to that organisation from where data are generated. The user needs and behaviour-related reports must be taken care of for improving the quality of library services and infrastructural facilities. The libraries themselves design a system to fulfil their specific objectives by using appropriate and adequate methodologies to examine user‟s need.

The role of the library in the educational system and in the information retrieval process is very significant. Thus, for making effective use of library resources, the interaction of the users‟ community with the library system is essential.

Keeping the above fact in mind, we have to identify the reality of this system. What is the information needed for users? What kind of facilities exists for meeting those needs? What process is being adopted for the promotion of library resources and services? How does the user react toward library services? How many information sources are being used? The role of the library within the library system should be evaluated, assessed and justified within a given time. The existing library services, resources, tools and equipment, and ICT system must be up-to-date. It may be concluded that user studies are an effective way for the library to introduce users' feedback. The outcomes of the users‟ studies are related to statistical analysis for library use, information retrieval process, and needs of the users for improving and restructuring library services. In general, the scope of users‟ studies would assess the following fact:

- Use pattern of the library, the frequency for use of library resources, and ease of to access in the library.
- Users' priorities, their needs and expectations from library staff, preferences for use of library collection, services and systems of the library.

- Assessment of library collection (e-resources and traditional resources both), library services, and library personnel regarding users‟ satisfaction.

Generally, the users‟ studies are survey oriented. The data collected from these surveys are helpful in the allocation of finance and human resources. They are also used to inform decision-making and strategic planning for different library units.

The data collected from the survey was also used to study the political process. Sometimes it is used for presentation to improve the library practice and convey the real fact of the library to faculty members, academic councils and library advisory boards to support for the betterment of the library. The user's survey data are also used in preparing proposals for grants for financial assistance.

What is happening in the library? Sometimes data collected to know this fact provides surprising results. Certainly, these results may be helpful to improve the quality of library services, interaction with users and other related plans. The following applications may be indicated from the output of the research obtained from users‟ studies: The users‟ studies are helpful collection development of the library. It may be useful to take decisions on the subscription of information resources like books and journals in both print and electronic format. Users‟ studies may be used in making a budget, subscriptions of e-journals and other library facilities to improve the library system.

It may also be used to meet users' needs and expectations regarding information resources. All the library services like reference, circulation and resource sharing (interlibrary loan and document delivery services) can definitely be improved by using the results of users‟ studies.

11.7. TYPES OF RESEARCH OUTPUT ON USER STUDIES

It has already been stated that the research output of users‟ studies may depend on the researcher's interest and choice. It must be carried out by the librarians or researchers of the library and information science disciplines or any other individual/body for having specific objectives. Some of the researchers share their views by learning about the experiences of librarians or library personnel. These experiences may be useful for the development of the concerned library. These views may be taken as a research output for certain specific objectives.

Librarians can also try to identify the users‟ interest regarding the availability of library material and facilities available for them. They can also conduct a survey by putting research questions to know their views on the betterment of the library services and to measure their satisfaction. They can use this significant data/information for a report on their own library. The scope of this kind of report may be limited to the concerned library only. It cannot be generalised to the entire system working for the library as it was designed for a very specific purpose. If the data/information used in the report has a wide vision for certain issues related to some kind of libraries then only the output of research must have a broader impact on the libraries. This will definitely ensure qualitative library services.

We know that the process of thinking differs from man to man therefore this phenomenon will also influence the research output of the users‟ studies. While making a review of literature for any research study we prepare a variety of research outputs concerned with the subject. The review of the literature output of the research studies may consist of different characteristics like descriptive, constructive, real, hypothetical etc. It can use descriptive and prescriptive models and positive and normative methods in preparing the literature survey. A review of the literature is the base for that study which has been carried out by the researcher.

It may be fully based on that theme or related to them to some extent. Some of the studies conducted earlier employed a variety of research methods. The researchers have different approaches in the study and have given different outcomes for their users and libraries. Most of the studies related to the users may be different by their nature. However some of the general type of user studies are as follows:

1. Survey on library and library use

2. User's priorities (Choice, Interest, Liking etc.)

3. User satisfaction and behavior.

A large number of studies have been made so far by individuals or institutions. These studies belong to different places, different disciplines, and different approaches. In India, most of the studies related to users are carried out by individual researchers only for certain specific purposes. The scope for the evaluation process for libraries in India is not as encouraging as desired.

There are a large number of institutions working in the concerned field at the international level. They are making approaches to provide qualitative services to their users. For which they are regularly conducting a survey related to users and the library. Some of the popular organizations/institutions mentioned here for the said purpose:

11.7.1. Tenopir and King

National Science Foundation (NSF) developed a questionnaire under contract for surveys in universities and other settings in 1977 (http://web.utk.edu/~tenopir/research). A large number of surveys were conducted by the researchers on scientists, engineers, medical researchers, and social scientists in addition to other professionals and students. Most of the surveys applied the same questionnaire with some modifications to reflect technological changes. James Evans (Boyce et al. 2004; Tenopir et al. 2004) explained reading patterns and citation patterns for science and publishing communities, online and electronic journals. They expressed that journals freely available online cited even less. The reading patterns and citation patterns differ in researchers while research and writing. The percentage of searching is high but the citation is low.

11.7.2. LibQUAL+ TM

The online survey is conducted by several libraries but this trend is popular in American and European countries. As far as India is concerned it is limited to individual researchers only. The majority of the libraries in India are not so interested to make self-surveys to evaluate their services. Some of the libraries situated in western countries are using LibQUAL+ TM for surveys. The brief information for the same is as follows:

LibQUAL+ TM is a survey method used by libraries to understand their users‟ experiences and to improve their quality of service. Central to the program is a web-based survey in which library users evaluate the offered products and services and offer suggestions for improvements. The questionnaire gauges the user‟s expectations and the mate of his or her satisfaction with the level currently offered for each part of the services. LibQUAL+ TM has participating libraries in Canada, the US, Australia, the United Kingdom and other European countries. LibQUAL+ TM is a survey conducted online. To fill out the questionnaire you will need an internet address. That link was sent to you via your university email account. All the data is stored on a server in the United States.

There are a number of libraries making an online surveys for research. The University of Sussex Library conducted a survey in 2011 and found it suitable to review the services of the library. Similarly, British Library, Wadsworth Library and The Davidson County Public Library System also conduct online surveys. Apart from these mentioned libraries, several other libraries also are conducting an online survey to find out how our patrons use the library‟s computers and Internet connection. The surveys are helpful for libraries to improve their technology services and communicate the value of providing free access to computers and the Internet within the community.

11.7.3. Super Journal project-1995- UK

Super Journal is an electronic journal research project developed by a consortium of publishers and UK universities to investigate user expectations of electronic journals and the factors that will make future services successful. The Super Journal Consortium includes approximately 20 societies, university press, and commercial publishers. Academic Press Ltd., Blackwell Publishers, Blackwell Science Ltd., CAB International, Cambridge University Press, Carfax Publishing Company, Chapman & Hall Ltd, Churchill Livingstone Ltd, Elsevier Science Ltd, Institute of Physics Publishing Ltd, Institution of Electrical Engineers, Macmillan Publishers Ltd, Oxford University Press, Rapid Science Ltd, Routledge Ltd, Royal Society of Chemistry, Sage Publications Ltd, Society for Endocrinology, Taylor and Francis Ltd, John Wiley and Sons Ltd. are included in the Super Journal consortium.

The Super Journal has developed a platform for journals in the sciences and social sciences for readers to have value in their subject disciplines. It gives new insight to authors to submit content with full text to explore it for further research. It has also developed production and delivery models for publishers for scalable distribution of electronic journals in a network environment. It has developed technical and organizational models for libraries to provide electronic journals to readers and provide user support.

11.7.4. Pew Internet and American Life Studies

Pew Research Center is a nonpartisan fact tank that informs the public about the issues, attitudes and trends shaping America and the world. It conducts public opinion polling, demographic research, media content analysis and other empirical social science research. Pew Research does not take policy positions. It is a subsidiary of The Pew Charitable Trusts. Cell phones and social media platforms like Facebook and Twitter are playing an increasingly prominent role in how voters get political information and follow election news, according to a new national survey by the Pew Research Center.

1.7.5. Council on Library and Information Resources

The Council on Library and Information Resources is an independent, non-profit organization that forges strategies to enhance research, teaching, and learning environments in collaboration with libraries, cultural institutions, and communities of higher learning. CLIR aspires to transform the information landscape to support the advancement of knowledge. CLIR promotes forward-looking collaborative solutions that transcend disciplinary, institutional, professional, and geographic boundaries in support of the public good. In pursuing its mission, CLIR is committed to:

- Building trust
- Retaining independence
- Fostering collaboration
- Cultivating effective leadership
- Capitalizing on strategic opportunities

The organization advances its mission through project initiatives and partnerships, publications, the DLF program, and award and fellowship opportunities. Through CLIR Connect, CLIR provides a forum for discussion, exchange, and collaboration. Washington, D.C. Data are now available from a large-scale study of how information usage patterns are changing among undergraduates, graduate students, and faculty members in U.S. academic institutions. The report, Dimensions and Use of the Scholarly Information Environment: Introduction to a Data Set Assembled by the Digital Library Federation and Outsell, Inc., is available at http://www.clir.org/pubs/abstract/pub110abst.html.

11.7.6. High Wire

High Wire Press is a leading ePublishing platform for societies, associations, university presses and independent scholarly publishers. HighWire collaborates and facilitates digital resources like journals, books, reference works, and proceedings for the readers‟ community and researchers. It has approximately 3000 journals. The complete manuscript submission, tracking, peer review, and publishing system for journal editors are offered by High Wire. It has excellent technology and support services for its members. It plays a significant role in online publishing. High Wire started a Journal of Biological Chemistry and Neuroscience. The JBC is Online and affiliated with Stanford University since 1995. Librarians and other information professionals support it for online subscriptions and reports.

The HighWire portal provides a centralized interface for administrators to manage their accounts for publications. The users of its publications are researchers, clinicians, scholars, and students.

11.7.7. Ohio LINK

The Ohio Library and Information Network (OhioLINK) is a consortium of 90 Ohio college and university libraries, plus the State Library of Ohio, that work together to provide Ohio students, faculty and researchers with the information they need for learning, teaching and research. Serving more than 600,000 students, faculty, and staff, OhioLINK‟s membership includes 16 public/research universities, 23 community/technical colleges, 52 independent colleges and the State Library of Ohio. Together, OhioLINK and its member libraries provide access to:

- Nearly 50 million books and other library materials
- More than 100 electronic research databases
- Millions of electronic journal articles
- Over 81,000 e-books
- Thousands of images, videos and sounds
- Over 39,000 theses and dissertations from Ohio students

11.8. DIRECTORY OF OPEN ACCESS JOURNALS (DOAJ)

DOAJ is an online directory of open-access journals consisting of 1,824,687 articles from peer-reviewed journals. There are 10,189 Journals available for proliferation in 136 Countries for freely accessible to the readers. The DOAJ provide quality open access and indexing services related to journals for wider use, promotion and impact. The main aim of the DOAJ is to increase the visibility and ease of use of open-access scientific and scholarly journals.

The DOAJ is making continuously efforts for the development of subject-specific resources, e-print archives and collections of learning objects. The DOAJ provides a very valuable supplement of scientific knowledge to the existing types of published scientific information (books, journals, databases etc.). However, these valuable collections are difficult to overview and integrate in the library and information services provided by libraries for their user constituency (http://doaj.org/about).

Open access journals are defined as journals that use a funding model that does not charge readers or their institutions for access. From the BOAI definition of "open access", we support the rights of users to "read, download, copy, distribute, print, search, or link to the full texts of these articles" as mandatory for a journal to be included in the directory.

11.9. JSTOR

JSTOR is a non-profit making organization founded in 1995. It has more than 2,000 academic journals to help academic libraries and publishers. It also has thousands of monographs and other materials relevant to education. JSTOR has shared a digital library to help universities and colleges to save costs, and provide access to its contents and space on their shelves. JSTOR has digitized more than 50 million pages and continues to digitize approximately 3 million pages annually. There are a large number of studies available in the JSTOR on users" studies. A few of the articles from JSTOR have been taken and summarized as follows: Wilson, T.D. elaborated on sixty years of the best in information research on user studies and information needs. The details are available at www.emeraldinsight.com/0022-0418.htm.

Lois, Bebout, Donald Davis S, JR. and Donald Oehlerts (1975) have described that user studies in science and technology have been conducted for over twenty years, and during the last decade, there has been a growing interest in social scientists as information users. However, humanities have largely been overlooked. Yet, frequently one hears the comment that humanists use the library to a greater extent than do researchers in another field. Citation studies have been done in a limited number of subject areas; e.g. Gleaves (1960) and Bolles (in preparation) in American literature; Broadus (1953) in speech; Tucker (1959) in philology; Vaughan (1959) in music; Simonton (1960) in the fine arts.

Geoffrey Ford (Ed. :1976) has made a study on library users. It was the first publication of the Centre for Research on User Studies. The inadequacies of many user studies and the reasons for these shortcomings were explained in this study. It has been stated in this study that "the user's awareness of and ability to use information sources is often imperfect." The study concludes: "Perhaps the first goal of research in this field should be to achieve convincing demonstration of the necessity (of information use)."

Paul, Conway (1986) stated that the continuing reluctance of the archival profession to develop a better understanding of users seems less a problem of will than a problem of method. The framework presented here is a first attempt to structure a comprehensive program of user studies. Built on definitions of users, information needs, and use, the framework combines the basic elements of information. It should be recorded, analyzed, and shared among archivists by collecting information. The author illustrates how parts of the framework can be implemented as an ongoing program with a reference log and suggest applications of the framework at the personal, repository, and professional levels.

Lynn Westbrook (1993) has made a study on User Needs: A Synthesis and Analysis of Current Theories for the Practitioner. The author found significant developments in the study of user needs during the last twenty years. The paper examines, synthesizes, and, on a narrower scale, analyzes such developments in an effort to determine areas of consensus in the field concerning specific aspects of greater interest to the practising librarian. In an effort to shed light on consensus, the paper is organized into six parts: the user, information/knowledge, information seeking, using information/knowledge, the system, and future research needs.

The author feels that the last two decades have witnessed significant developments in the study of user needs. The purpose of the study is to synthesize and, to a more limited extent, analyze those developments in an effort to determine areas of consensus in the field, particularly those points of greatest value to the practising librarian. Virtually all of the material examined herein relies on grounded theory; local applications and reports are beyond the scope of this review. In an effort to highlight consensus, the following six-part organizational structure has been established i.e. the user, information/knowledge, information seeking, using information/knowledge, system, and future research needs.

Ruth, A. Palmquist (2001) provided an overview of usability literature and testing methods. Usability is a term shared by a wide variety of interests in the commercial software development arena, and it is a notion that argues for the centrality of the user - a focus long held by the library and information science (LIS) professions. As more information centres and libraries turn to a Web-based portal to introduce their users to the resources and services they provide, the need to create usable Web-based information displays emerges as a critical task for LIS professionals.

Usability testing can be helpful in capturing the user's experience with electronically provided information and can be helpful in determining the success of Web-based efforts. Usability testing techniques were developed as a curricular focus without expensive lab equipment. Further, these elements seem a natural approach for developing LIS graduates, and in our own efforts to understand the effectiveness of Web-based information services, the ability to better assess a user's information-seeking activity.

Micheline Beaulieu (2003) concluded that user-based studies have evolved linking together studies on information use and provision, information-seeking behaviour and the design and evaluation of actual retrieval systems. Amanda Spink and others (2007) have made a study on multitasking information behavior in public libraries. Multitasking information behaviours may involve a combination of cognitive and physical actions on dual or multiple tasks, concurrently or sequentially, including switching between different information tasks. The major finding of the study is that many people in libraries are seeking information on multiple topics and are engaged in multitasking behaviours.

Terrence B. Bennett and Shawn W. Nicholson (2007) stated that the burgeoning use of numeric data resources across all academic disciplines raises significant questions about the library‟s role in providing data services and promoting quantitative literacy. This study analyzes the content of web pages to determine the presence and promotion of data resources and services at a random sample of large research libraries (and their related institutions) in North America.

The results prompt the authors to challenge libraries to more fully engage their users in efforts at richer discovery, use, and analysis of data.

Aristeidis Meletiou (2010) has mentioned a methodology that evaluates offered services by correlating three important factors that characterize them: Users‟ Satisfaction of a Service, Usage and Cost of this service. These factors are very important as they would be able to express clearly the efficiency and the purpose of service in a Library organization. In these competitive years of continuing change, libraries enrich their services with modern technologies and innovative approaches to satisfy users‟ standards. This engagement significantly increases the effects of these new inputs on library budgets as new technology applications demand money and new organization schemes.

Consequently, the annual budget has to be increased and difficulties arise due to its efficient allocation. This paper describes a methodology for evaluating offered services by using specific important factors like Users Satisfaction with a Service, Usage, and Cost of this service. Known methods for estimating Costs (ABC method) and estimating Satisfaction (MUSA method) in library fields are used. Also, the multi-criteria method to evaluate a service by correlating the above-mentioned factors is used to give the observer the ability to find useful information. Finally, a case study about the evaluation of services using the proposed methodology is presented. The goal of the proposed methodology is to help library decision-makers choose the most appropriate services to offer change and improvements according to user needs and allocated budgets. Bernard J. Jansen, Kate Sobel and Geoff Cook (2011) have illustrated information sharing within social networking services (SNSs) like Facebook, MySpace and Twitter.

Isto Huvila, Stefan Ek and Gunilla Widén (2014) have made a study on information sharing. They told that Second Life (SL) is an online virtual world. It is a social venue for work, learning, education, entertainment and cooperation that reflects the activities and interests of its users (residents in SL terminology. The study is based on a qualitative analysis of open-ended data collected using a web survey of Second Life users.

11.10. SUMMARY

User studies are one of the most researched areas in library and information science. A large number of studies carried out in different disciplines over the last eight decades. These users‟ studies constitute a large amount of literature in the related disciplines. The research on user studies was started in the late 1940s and thereafter it has constantly increased. Now, a literature review shows the diversity and plethora of topics explored by various studies at various levels. User studies are investigations of the use and users (including non-users and potential uses and users) of documents, information, communication channels, information systems and information services. Wilson (1981) writes that the first user study is commonly recognized as a publication at "The Royal Society‟s" conference in London in 1948. Several users‟ studies have been made since the decades in which the use of libraries, databases, media, documents or "information" was treated as the dependent variable, while the sex, age, job, geographical location or institutional affiliation were treated as the independent variable. These kinds of studies in Library and Information Science (LIS) have been carried out in different disciplines and at different times in different places. The research output on user studies is probably in the same direction in almost all the disciplines but their conditions are different.

11.11. MCQ QUESTIONS

1. Super Journal project- UK is an electronic journal research project developed by -A. UK and USA B. Consortium of publishers C. India D. Eastern countries

2. The survey can be conducted: A. Only Online B. Only Offline C. Neither online nor offline D. online or offline both

3. The output of the user studies is supposed as "________" measures. A. outcome B. input C. users D. quality

4. LibQUAL+ TM is a survey method used by libraries to understand their ________ A. future budget B. library resources C. library personnel D. users experiences and to improve their quality of service

5. LibQUAL+ TM has participating libraries in ________ A. China, the US, Australia, the United Kingdom and other European countries B. Japan, Australia, the United Kingdom and other European countries C. The US, Australia, Canada, the United Kingdom and other European countries D. None of the Above

6. LibQUAL+ TM is a survey and conducted _______ A. offline B. online C. offline and online both D. None of them

7. The Council on Library and Information Resources is an ____ organization. A. dependent and profit B. dependent and nonprofit C. independent and profit D. independent and nonprofit

8. How many types of the survey were conducted for research on user studies? __________

9. The Ohio Library and Information Network (OhioLINK) is a consortium of _________ A. Ohio university libraries B. Ohio college libraries C. Ohio Government libraries D. Ohio college and university libraries

10. Super Journal project- UK is an electronic journal research project developed by -A. UK and USA.B. Consortium of publishers. C. India. D. Eastern countries.

11. The survey can be conducted: A. Only Online B. Only Offline C. Neither online nor offline D. online or offline both

12. The output of the user studies supposed as "_________" measures. A. outcome B. input C. users D. quality

13. LibQUAL+ TM is a survey method used by libraries to understand their _______ A. future budget. B. library resources C. library personnels. D. users' experiences and to improve their quality of service.

14. LibQUAL+ TM has participating libraries in ________A. China, the US, Australia, the United Kingdom and other European countries. B. Japan, Australia, the United Kingdom and other European countries. C. The US, Australia, Canada, the United Kingdom and other European countries. D. None of the above.

15. LibQUAL+ TM is a survey and conducted _______ A. offline. B. online. C. offline and online both .D. None of them.

16. The Council on Library and Information Resources is an ________ organization. A. dependent and profit B. dependent and nonprofit. C. independent and profit. D. independent and nonprofit.

17. How many types of survey conducted for research on users' studies? ________

18. The Ohio Library and Information Network (OhioLINK) is a consortium of ______ A. . Ohio university libraries. B. Ohio college libraries. C. Ohio Government libraries. D. Ohio college and university libraries.

19. DOAJ is A. Online directory of open access journals. B. offline directory of open access journals. C. A and B both. D. None of them.

20. Fill the gap? "starting, chaining, __________, differentiating, monitoring, and extracting".

11.12. SHORT QUESTIONS

What is the meaning of Information Literacy Education?

Briefly describe Library Portal.

Define Information behaviour.

What is LibQUAL+ TM?

11.13. LONG QUESTIONS

What are the differences between Information Search Behaviour and Information use Behaviour?

What are the various types of Research output of user studies?

KEYWORDS: Information Literacy Education; Research Output; Research input

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UNIT 12

RANGANATHAN'S PHILOSOPHY ON USER STUDIES: WITH SPECIAL REFERENCE TO FIVE LAWS OF LIBRARY SCIENCE

12.0. OBJECTIVES

- To understand SR Ranganathan's Philosophy on User Studies.
- To know the Five Laws of Library Science in respect of user studies.

12.1. OUTCOME OF LEARNING

After reading this unit, you will be able to do the following:

- To understand Ranganathan's philosophy on user studies**.**
- To know the implications of the Five Laws of Library Science.
- To make an understanding of Five Laws vs. User Study

12.2. STRUCTURE OF UNIT

- Introduction
- Ranganathan's philosophy
- The Five Laws
  - First Law – Books are for use
  - Second Law – Every reader of his/her book
  - Third Law – Every book its reader
  - Forth Law – Save the time of the Reader
  - Fifth Law – Library is a Growing Organism
- Five Laws vs. User Study
- User studies and Library Services
- S. R. Ranganathan: Combining Library Services to Indian Values

- Summary
- References

12.3. INTRODUCTION

"The function of the library is to serve its users"

--Samuei Swett Green

Ranganathan‟s philosophy on user studies has a great contribution to the sustainability and development of libraries. Ranganathan‟s philosophy is a theory or attitude that acts as a guiding principle for user‟s behaviour. Ranganathan‟s philosophy is the study of the fundamental nature of knowledge, reality, and existence of libraries, especially when considered as an academic discipline. Today we are living in an information communication technology (ICT) driven environment and libraries are affected by the changes in the internal and external environments. Their operation, organization, services, and networks must be fine-tuned to meet the rising needs of the users. For this, he gave the five laws as guiding principles for the overall development of the library and librarianship and to improve the quality of library services for the betterment and satisfaction of the users. The libraries always have a purpose, mission, and objectives for their existence. For this user, studies are conducted by individuals and institutions in order to achieve the mission and to justify our existence.
Ranganathan‟s Laws may be treated as guiding principles to fulfil the objectives of the libraries. Ranganathan‟s five laws are:

- Books are for use.
- Every reader his/her book.
- Every book has its reader.
- Save the time of the reader.
- A library is a growing organism.

12.4. RANGANATHAN'S PHILOSOPHY

Dr S.R. Ranganathan's five laws are still relevant in digital communication technology and ICT-enabled scenario. These laws are helpful to librarians and the work done for the development of libraries and welfare of the society. Ranganathan expressed that "a library is a collection of books kept for use. Librarianship, then, is connecting a user and a book. Hence the very life of a library is in the personal service given to the people." (Ranganathan: The Five Laws of Library Science: 75).

Here, user satisfaction is the ultimate objective of the whole librarianship. Today we are living in the age of technology. Technology means, the application of knowledge to make human life easy and comfortable or knowledge dealing with scientific methods and their use in industries, organizations, processes and other activities. Talking Drums of Africa, Radio, Telegraphy, Telephony, printing and photography, Television, Digitization etc. are some results of the technology specially deals with production and transmission of information. In common sense, we call them Information Technology (IT). It is IT, which provides a nervous system to the global village society living on the earth. Libraries in the modern era are treated as gateways to information. The open information culture has shifted focus from subject experts and limited modes, which suits the needs of the users.

There is a need to provide users based or user-centric services to the users to satisfy their requirements. The face of information services is changing due to the application of information technology in the library. Dr. Ranganathan's philosophy is relevant and accepted as a way to overcome the library users‟ related problems. The answer comes in the application of his Five Laws of Library Science.

During his eighty-year lifespan, he devoted his life to the grounds of the development of library science in India.

Dr. Ranganathan vocalized various laws, principles, canons, theories, etc., in LIS. His theories are based on scientific principles.

We can say that his ideas are like a lighthouse for libraries, and users. His ideas are still exciting and, even today when computers and other developments in the field of telecommunication have changed the whole scenario of LIS. (AK Sharma) Libraries and Information Centers are facing the problem of underused information resources as well as the challenges of implementing Information Communication Technology (ICT) and these problems can also be solved by the Ranganathan‟s philosophy. It was natural for Ranganathan who was a lively teacher and had thrilling intellectual experiences with students and faculties of the Presidency College not to opt for the post of librarian, even though it carried a handsome salary. Ranganathan quite often narrated to us that he never wished to be a librarian. He said that chance had made him one, which he never regretted in his later life (Kent, 1978). In spite of his diffidence and lack of interest, he took charge as the Librarian of the Madras University on 4th January, 1924. He kept on working on Colon Classification and proved that the design and development a scheme for classification is a lifetime activity. From the end of his life to the very last day, Ranganathan kept on working. His life was a symbol of immortality. The integral nature of Ranganathan's theory emerged from occasional intuition; and his intellect strove to make it more explicit to the rational mind of the scientific worker. His contributions sometimes bordered on a poetic beauty and sometimes on uncouth prose - but his life and work in the field of library science modelled an ever-inquiring mind, well entrenched in the philosophy of *Bhagavad Gita*.

12.5. THE FIVE LAWS

The five laws of library science are playing very vital role in user education based on information communication technology scenario. In other words we can say that these laws can build great satisfaction among user‟s studies. The core meaning of "books are for use" is still about access; however, our interpretation focuses on developing the physical and technical infrastructure needed to deliver materials our interpretation of "every book its reader" focuses on increasing the discoverability, access and use of resources within users‟ existing workflows. It can be agree that "a library is a growing organism" and propose growing users' share of attention First of all, like any philosophy, it is important to realize that merely stating the five laws or even understanding the words will not automatically lead to enlightenment about the function of libraries. Prof R. N. Satyanarayana says that “Dr. S R Ranganathan has, in the simplest possible terms, enunciated the total philosophy of library science in the form of his five laws of library science, these principles when applied in practice indicate the best result of their adoption come out when library users are informed or taught the library skills in exploiting the resources and services to their maximum advantage.”

12.5.1. First Law – '*Books are for use'* It is imperative to ensure library users, use the materials mean to say that we select and purchase for them. Libraries are not just about storing books, they are about people having access to books. For proper uses of information there should be proper storage and dissemination of information.

12.5.2. Second Law – „Every reader his/her book'

This is user oriented law. Every user has the right to access the information (Right to Information Act, 2005). In other word we can say that our duty is to help users find the information they require and ensure any blocks in the way are not blocks we have created. This law guides the library or information professionals to take care of information users, so that they can access information without any obstacle. Here is a necessity of User Survey, User Study and User Education. User Orientation may help in acquiring the need and satisfying the purpose.

12.5.3. Third Law – 'Every book its reader'

Third Law is information oriented. We can interpret reader development as being part of the third law. In modern situation information professionals have to accept the information technology to organize and manage the information. Except in rural area, most of the university and institutions libraries in India are automated. Few of them have taken initiatives in digitizing the collections. Now e-books and e-journals have taken place into the libraries instead of the print collections.

12.5.4. Forth Law – 'Save the time of the Reader'

Under this Law Libraries must have the objective of saving the time of the user. This law highlighted on, how fast information can be delivered to its end users. ICT has helped user in getting their required information into their laptop, palmtop, and desktops. Today"s the concept "library without wall" has come into the picture. Through broadband connection information professionals serve the information to its clients with in a fraction of second.

12.5.5. Fifth Law – 'Library is a Growing Organism' Fifth law states that libraries will continue to grow in the future. Keeping in view the information available and growth in the area, it is impossible for the single library to acquire all the information of a subject. There is space problem, staff problem and most importantly the fund problem every library has. The fifth law's implication for latest technologies are adapting by the libraries to the future needs of user, including mobilizing resources, dealing with uncertainty about future user needs, new services, new customer groups, new environment, etc.

12.6. FIVE LAWS VS. USER STUDY

The relevance of Ranganathan's five Laws of Library Science in Libraries with user in the following manner:
(1) Books are for use; (Maximize the use of books/ information)
(2) Every reader his/her book; (User is prime factor and his/her need must be satisfied)
(3) Every book its reader; (Find a user for every book)
(4) Save the time of the reader; (Organize information in a way that the user finds the wanted information promptly)
(5) A library is a growing organism; (Emphasis is on comprehensive and evolutionary growth regarding collection and users Ranganathan (1953) in his five laws of library science have focused on uniting the users with their resource with the purpose to maximize the use and serving them to their utmost satisfaction.

12.7. USER STUDIES AND LIBRARY SERVICES

The user studies are basically carried out to improve the quality of library services. To improve user oriented services our libraries need to institutionalize library performance evaluation by user approach. This should be done annually in order to have a feed-back from the users on how well the library is meeting their information needs. Once measured, the processed result should be published in the institute's journal or library bulletin without any bias. Apart from winning support for the library, the exercise would sensitize the library staff to put in their best towards meeting user needs.

12.8. S. R. RANGANATHAN: COMBINING LIBRARY SERVICES TO INDIAN VALUES

SR Ranganathan always preferred to support his statements with old Indian wise sayings. These wise sayings were taken from various Indian sacred books. **"**During eighty years of his life span Dr. S.R. Ranganathan made a great contribution in the field of library and information science. He enunciated new laws, theories, canons, principles that paved a path to established library and information science as a subject. His theories, principles, laws, canons etc, are based on scientific principles; therefore, they are accepted universally and are relevant even today. It can be stated that his ideas are like a lighthouse for librarians, teachers and students in the field of library and information science." (A K Sharma) Ranganathan was very much influenced by Indian traditions. He pointed out these at various places. He quoted a stanza from Taittiriya-Upanishad. The Taittiriya-upanishad contains the following passage, embodying exhortation at the convocation. On the eve of a batch of students entering life.

अतिथि देवो भव	(The guest is your God)
श्रद्धया देयं	(Serve him, with all attention)
थश्रया देयं	(Serve him, to your utmost capacity)
ह्रिया देयं	(Serve him with all modesty without any touch of ego or prestige)
भभया देयं	(Serve him with a sense of fear, lest anything should go wrong)
संववदा देयं	(Serve him with a full knowledge of his needs).

We cannot find a clearer or fuller statement of the way in which documentation service should be given to a reader." (Ranganathan, Documentation: 1973:99). User is the priority; user satisfaction is the motto of whole librarianship. SR Ranganathan motivated professionals to serve the reader with all efforts and without ego. In the context of First law of library science he said librarians not to flirt with fruits and he quoted the words of **Shri Krishna:** „The right is to action alone and never to fruits. Let not the fruits of action be the motive. Nor let thyself be attached to inaction. (कर्मण्येवाधिकारस्ते र्ा फरेषु कदाचन। र्ा कर्मफर हेतुर्मू: र्ा ते संगोस्ृवकर्मणि।) (Ranganathan: Five Laws of library science) It is very difficult to attain this, but professionals have this kind of spirit, so they can serve the readers without having any demand.

12.9. SUMMARY

In the perspective of Ranaganathan"s philosophy we can say that above more valuable laws are very significant since the inception and they have relevancy with the users of modern era also besides the advent of various information communication technologies time to time. The first three of these laws centre on the singular relationship between a book and a reader. They are philosophical concerning the nature of people and things (books). The fifth is about the organic nature of library growth; it addresses change. Ranganathan recognizes that library growth, like growth in nature, may be episodic or periodic. In his chapter discussing the fifth law, it is clear that Ranganathan wants to treat the library as a unity. In simplest terms, Ranganathan is suggesting that a library is more than the sum of its parts. Today"s library users are raising expectations, diverse needs and wants, and choices. The notion of services has also changed, from basic to value added, from staff assisted to self-service, from in-house to outreach, from free to priced, from reactive to pro-active and from mass customization to individualized service. As in such an environment librarians are finding new ways of serving users effectively and efficiently. The Laws and theories provoked by Dr. Ranganathan can be considered as "benchmark" for User Studies.

12.10. MCQ QUESTIONS

1. Who propounded five laws of library science? A. WCB SayersB. Dr. Shri Ram RanganathanC. Melvil Dewey D. Dr. S. R. Ranganathan

2. Which law of library science emphasize the user studies for improving the organization and planning for library services? A. The First law of library science B. The Third law of library science C. The Fourth law of library science D. The Fifth law of library science

3. Which law of library science may be considered as norms for user satisfaction? A. The Second law of library science B. The Third law of library science C. The Fourth law of library science D. The Fifth law of library science

4. Ranganathan recognizes that library growth, like growth in nature, may be episodic or periodic. Fales/True

5. The core meaning of "books are for use" is still about access. Fales/True

6. ILA has published a Standard for Information Literacy and competency. Fales/True

7. Dr Ranganthan coined the phrase 'User Studies' Fales/True

8. HighWire Press is a leading ePublishing platform of ________ presses and independent scholarly publishers. A. societies B. Associations C. University D. All the above

9. JSTOR was founded in ________.

12.11. SHORT QUESTIONS

Write down the five laws of library and information science.

What is the meaning of the first law of library and information science?

Why are library user studies important?

12.12. LONG QUESTIONS

Describe Ranganathan's philosophy in detail.

What are the implications of the Five Laws of Library Science on a library Catalogue?

KEYWORDS: Ranganathan’s philosophy; Five laws

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UNIT 13

RECENT TRENDS IN USER STUDIES

13.0. OBJECTIVES

The objectives are: User Study, Recent Trends, Digital Environment

13.1. OUTCOME OF LEARNING

After reading this unit, you will be able to learn, to understand the Recent Trends of User Studies in the Field of Library and Information Science.

13.2. STRUCTURE OF UNIT

- Introduction
- Genesis and development of user studies
- Recent user studies
- Recent trends in user studies
- Implementation of user study's results to improve library services
- Summary
- References

13.3. INTRODUCTION

'User studies' means 'library survey'. It is a 'library survey' because studies of information need or information use behaviour or reading habits concentrate upon a wider range of information sources and channels other than simple libraries. 'User Study' is a difficult area of knowledge to define. It can include a traditional or conventional survey of library borrowers and it may be the main form of activity which comes to mind when the term ‘user studies’ is mentioned.

A study entitled “Pilot Study on the use of scientific literature by scientists" conducted by **Ralph R. Shaw** (1956) is considered a pioneer study in this direction. There was comprehensive bibliography on user studies compiled by **Davis** and **Bail** in 1964 containing 438 studies. One of the turning points in the history of user studies was the establishment of the “Centre for Research on User Studies” (CRUS) in 1975 at the University of Sheffield. The purpose of the centre is to create a national centre to act as a focus for research in user studies. User studies have a number of impacts on library services and systems. User studies directly or indirectly, play a pivotal role in systems and services, such as collection development, resource allocation, improvement of library techniques etc.

13.4. GENESIS AND DEVELOPMENT OF USER STUDIES

In the year 1948 User Studies was first introduced at the Scientific Information Conference of the Royal Society. At this conference, **Urquhart** and **Bernal** presented their research findings. The study was conducted in eight research and educational institutions. In an earlier stage of user studies, it was mainly related to scientists who were associated with disciplines like Biochemistry, Medicine, Engineering, Physics etc. The concentrations of user studies on these subjects were on the fact that the publication of professional and scientific information in these disciplines was adequate at that time in comparison with the humanities. This resulted in the earlier development of information handling tools like indexes and abstracts. In the early 1960s, the presence of literature shows that the number of studies increased rapidly. At that time many user studies were focused on document studies. In the 1970s researchers targeted the user groups like Magistrates, Urban Citizens, personnel working in local authorities, and University students, and they also mark the point that in the user studies of the use of particular information systems, their efficiency would be examined. So, we can say trends of user studies were system-centred studies. The 1980s was the era which was known for an increasing awareness surrounding the conceptual framework and methodological issues of user studies. The first attempts at this awareness were the publication in the journal of Social Science Information Studies. In the 90s the implementation of the conceptual framework of theories was strengthened. With the presence of ICT-driven gadgets, mainly Internet has been considered the main source of information. Now the Internet has become a powerful source of information. These results a number of studies set out to investigate multiple issues concerning the impact of the Internet on the user and the information community. www.librijournal.org/pdf/1999-3pp132-141.pdf

13.5. RECENT USER STUDIES

13.5.1. International Scenario

The upcoming trend in user studies is a result of technological advances and changes in the economics of information systems. Modern digital libraries have multiple diverging requirements and expectations of the users and rapidly changing technological innovations. Many studies have looked into digital libraries in specific contexts. **Bishop** (1999), **Covi** and **Kling** (1997) studied the use of digital libraries by people from different social and economic backgrounds. **Furnas** and **Rauch** (1998) studied the use of digital libraries and conclude that in searching for information a ‘one-shot query’ is very rare. www.uclic.ucl.ac.uk/annb/docs/DLuser.pdf

A rather specific or a small group of Digital Libraries (DLs) are addressed by many studies and in development, DLs are seldom addressed. They know how to compare the user experience is essential to be able to compare DLs. Usability is the major form of the study, and to contextualise specific DLs user studies and both information behaviour and user experience studies, a more informed approach needs to be followed.

Jones and **Cockburn** (1996) studied different www browsers in terms of their navigational support. **Marshall** et al. (1999) studied the use of digital reading devices. **Adler** et al. (1998) discussed categories of reading to discuss categories of writing in relation to documents. These ideas will have an impact on the design of digital libraries as working environments. **Allen** (1998) discusses the user interfaces for different tasks. He found that users with well-developed special abilities were better able to use specially organised query tools than those with perception abilities were better developed. This will provide help to design the digital library interfaces. **Jones** et al. (1999) studied the differences between user interfaces through experimentation. **Sugimoto** et al. (1997) also followed this approach when comparing five different user interfaces to support access to digital libraries. Similarly, **France** et al. (1999) studied the use of digital library user interfaces by giving subjects several tasks. **Allen** (1998), **Bishop** (1999), and **Park** (1999) used experimental design for comparing the applicability of user interfaces for digital libraries and **Jones** and **Cockburn** (1996) in terms of www browser usability. Several studies (**Bishop,** 1998; 1999; **France** *et al.*, 1999; **Marshall** *et al.*, 1999) employed transaction logs to gain an understanding of the activities users were engaging in with digital libraries. >www.uclic.ucl.ac.uk/annb/docs/DLuser.pdf<

Various data collection techniques have been used to analyze the use of digital libraries. The usability testing technique was used by **Allen, Bishop**, **Park** and **Sugimote** *et al.* to compare the applicability of user interfaces for digital libraries. **Bishop, Covi** and **Kling** relied on interviews to access people's perceptions and use of digital libraries. **France** *et al*. **Jones** *et al.*, and **Marshall** *et al.* used transaction logs to understand the activities of users within digital libraries. The Diary study method was used by **Adler** *et al.* and **O'Hara** *et al*. Other methods like questionnaires, observation and focus groups were used to understand the usability of systems.

User studies are moving into a mature generation by building on earlier foundation research. **Wilson** (2000) discussed that Action research and Qualitative research are appropriate methodologies for the study of human information behaviour. According to **French** and **Bell** (1973), Action research is an integral part of the organisational development consulting process. "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework" (**Rapoport**, 1970: 499)**.** www.bogliolo.eci.ufmg.br/.../WILSON%20Information%20Research.pdf

Now Qualitative research is another emerging trend in information science, originating in social science. Under one school of thought, "Qualitative research is concerned with developing concepts rather than applying pre-existing concepts" (**Half Penny**, 1979) and given the state of theory in information science, it can well be arranged that 'developing concepts' is what is needed. Qualitative research is suitable to study information-seeking behaviour. >http://en.wikipedia.org/wiki/Qualitative_research

The above studies reiterate that digital libraries are the focus area of many studies. Several studies have focused on user interfaces and search techniques. But there are fewer studies carried out as compared to studies in the area of hypertext, WWW, lesser extent browsing in digital libraries and information retrieval fields. There is a strong need to focus on users' requirements for information sources.

Academic libraries have now been restored to introduce instructional courses such as library orientation, faculty development programmes and bibliographic instructions to stimulate the use of library resources by students. It is more focused on the needs of its users. (Kronick, 1982) Many studies conducted in the field of public libraries. These studies include mostly use studies, behaviour studies etc. of the users of public libraries. A study on library surveys in Australia revealed the social characteristics of public library adult users. This study found that most of the frequent users had a higher standard of education or belong to a higher professional group. The study found a likely increase in public library users with the exception of some disadvantaged groups (Rochester, 1982). In the USA, because of the introduction of media in public libraries, the use of state and local libraries is on an uptrend among better educated and more advanced.

Even in special libraries, the impact of user studies is significant. It helped in understanding the basic requirement and preferences of users of such libraries. This led to networking and computerisation in special libraries. They now use consortia on the network as bibliographic centres for interlibrary loan and reference services.

13.5.2. National Scenario

A significant effort was made by INSDOC (now NISCAIR) and conducted a Use Survey entitled "INSDOC List of Current Scientific Literature" in 1964. After that INSDOC compiled "Indian Science Abstracts". IASLIC conducted a seminar on "User and Library and Information Services", and pay attention to users. In the year 1967, INSDOC conducted a pilot survey to access the information needs of the researchers of electronics. One pioneer study was conducted by M. S. Sridhar. This study was conducted at ISRO Satellite Centre (ISAC), Bangalore. The results of this doctoral work have been published under the title "Information Behaviour of Scientists and Engineers". The user studies take an exponential growth in recent years. It can be easily found in the literature of library and information science that the majority of research leading to M. Phil. and Ph. D. Degree are conducted on user studies.

- **Academic Libraries** Numerous studies in the field of academic libraries were conducted in recent years. Some well-known user studies and their results are below: "Information Seeking behaviour of the academics of the University of Kerala in the changed Library Environment" by Shibu Rays and M. D. Baby (2011) reveals that academics have welcomed the automation of libraries, and a shift towards electronic information seeking is visible, which implies that ICT has an impact on the information seeking behaviour of the academics. "Information seeking behaviour of the academics in Government Colleges in changing scenario" by Jogender Singh (2010) concludes that academics have welcomed the automation of libraries. Some remarkable studies in this field are "Use of library resources in university libraries by the students" by Md. Sohail and others (2012), "User perception and use of library and information services in the higher research and academic institutions in Lucknow city" by K. L. Mahawar (2011), "Uses of e-journals by researchers in AMU" by M. M. Raza and A. K. Upadhyay (2006), etc. The well-known user studies in this field were conducted by: P. Geeth (2003), Varghese (2006), M. S. Lohar and T. N. Roopashree (2006), Lalitha K. Sami and Rabia Iffat (2009), D B. Patil and S. Parameshwar (2009), Y. Srinivasa Rao and B. K. Choudhury (2008), B. U. Kannapanavar and K. V. Manjunatha (2010), B. D. Kambar and Gururaj Hadagali

(2009) entitled “Use of UGC-INFONET journal consortium by faculty members and research scholars of Karnataka University” etc.

- **Public Libraries** User studies in the field of the public library are less as compared to academic and special libraries. An important study entitled “User survey of selected public libraries of West Bengal by Amit Kumar Bandyopadhyay (2004) was carried out. This study highlights that only 14.13% of the users found during the survey are female. There is no reader of the ST category although a high percentage of the population belongs to this category. This was part of a major research project, funded by the UGC (India). A pioneering study in this field was “E-reading habits of public library users in Erode corporation, Tamilnadu: A survey” by M. R. Ramesh (2012).
- **Special Libraries** A number of studies have been conducted in the past to assess the information requirements of scientists, engineers and technologists. The important findings of some of the studies are below: “Use of electronic resources by research scholars in CFTRI, Mysore: A study (2005) by Mallinath Kumbar and others. It is clear from the study that how electronic resources are useful to research scholars. This study helps librarians in planning and developing electronic resources in providing modern services to their library users. Another important study entitled “Information used pattern of social scientists: An analysis of citation of journals of Asian studies” (2007) by Neena Talwar Kanungo. The study highlights the low use of electronic sources can be a good area of research in future. The accessibility of online electronic sources should be more utilised by social scientists.

Some remarkable studies in various allied fields such as forestry were carried out by T. Hazarika (2005) entitled “Information use pattern of Indian forestry scientists: A bibliometric study”. M. Ahmad and S. Haridasam (2006) carried out a user survey on “Use of the periodical by scholars at National Library of Veterinary Science”.

Another study on this subject was carried out by Biswas and Enamul Haque (2008). In recent years user study on special organisations was also noticed. Mahawar and others (2009) studied “Information seeking behaviour of Geologist”. “Information-seeking behaviour of users of the cyber library: A case study of Tata Institute of Social Science” by Kiran Kaushik and others (2011). The study revealed that cyber library was extensively used by male users as compared to female users and users preferred using particular databases only.

- **Digital Libraries** Today in libraries and information centres various kinds of electronic resources have been produced by applying modern IT. The commonly available electronic sources are competing with and in some instances replacing, the print-based information sources, which have been in place as the primary media for storage and communication of recorded information. Because of this reason, many user studies in this field were conducted by Lohar and Roopashree (2006), D. B. Patil (2009), A. Manimekali (2006), S. Patil (2007), Y. Srinivasa Rao (2008), Rama Devi (2006), Lalitha K. Sami (2009) etc. One remarkable study carried out by Sadanand Y. Bansode and Shamin Periera (2008), entitled “A survey of library automation in college libraries in Goa State” concluded that library automation began in 1970 in a few special libraries and has now reached most University library. Due to various problems, many college libraries in India have yet to take off in India.

13.6. RECENT TRENDS IN USER STUDIES

Recent trends, which have come to the forefront during recent years, are detailed below:

13.6.1. Field of User Studies

In the past few years, a considerable amount of user studies /surveys have been conducted to examine the user's needs, expectations and satisfaction with library services, facilities, collection and staff. Content Writer observed nearly about 120 studies from leading journals (ILA Bulletin, IASLIC Bulletin and SRELS Journal of Information Management) from 2000 to 2014 and concluded that maximum user studies were carried out in the field of the academic library (61.6%) followed by special libraries (21.6%). The weak area of research in user study is the public library (4.3%), whereas other fields are covered (12.5%). It is also observed that some areas are less covered by researchers for conducting user studies, these areas are studies on women, rural areas, farmers, medical science and veterinary science, banking sectors and physically disabled persons etc.

13.6.2. Methods, Tools and Techniques used in conducting User Study

A survey approach was used for conducting maximum user studies and primary data were collected through questionnaires, interviews, schedules etc. A random sampling technique was adopted for various studies. Some studies used the chi-square test for analysing data. Statistical tools such as percentage, chi-square, 't-test and one-way ANOVA were used to analyze the data using the SPSS software package. Many researchers use the FoxPro Database Management Software (DBMS) to analyze the data.

13.6.3. Categories of User Study

On the basis of observation of about 120 User Studies (ILA Bulletin, IASLIC Bulletin and SRELS Journal of Information Management) from 2000 to 2014, Content Writer found that:

- 42.5% of studies were conducted to find out the overall pattern of interaction of the users' community with the communication system called Communication Behaviour Study.
- 24.2% of studies were conducted to find out the use of communication media like primary, secondary periodicals etc.
- 18.3 % of studies were conducted to find out the pattern of flow of information in the science communication system as the hole.
- 15% of studies were conducted to find out the extent of use of services and facilities offered by libraries.

13.6.4. Conferences and Seminars on User Studies

It is evident from the following data, that user studies including information-seeking behaviour, information needs, use patterns, information sharing patterns etc. were the focal point of various conferences, seminars, and workshops conducted in various parts of the world. A list of some important conferences, seminars and workshops is given below:

(i) The Conference of Digital Information Technology held at Amman-jordan (2014). (a) "User
studies for and evaluation of digital library systems and applications", (b) "User behaviour and
modelling" (c) "User's mobility and context awareness in information access" and (d) "User's
interfaces for digital institutions" were conference topics.

(ii) 2nd National Conference of Society for Promotions of Libraries (SPL) on "Libraries: Towards Digital Paradigm" held at CSJM University, Kanpur (2014). "User Expectation, Experience in Modern Library System: Case studies, was one sub-theme.

(iii) National Conference on Management of Modern Libraries held at Manipal University, Manipal (2014). "Users, user needs and expectations" was one sub-theme.

(iv) National Seminar on Reengineering Academic Libraries held at Pt. Ravishankar Shukla University, Raipur (2014). "Information Use and Information Seeking Behaviour" and "User Need Mapping/needs Mapping" were sub-themes.

(v) National Seminar on Challenges in Library Management Systems held at IACS, Kolkata (2012). "User Interfaces" and "User Needs and Satisfaction" was two sub-themes of the seminar.

(vi) International Conference on Academic Libraries held at Delhi (2009). "User-centric services, reference and outreach" was a subtheme in the International conference.

(vii) 49th ILA conference on "Responding to Users' need in changing information landscapes" held Bundelkhand University Jhansi (U.P.) (2003-04).

13.7. IMPLEMENTATION OF USER STUDY'S RESULTS TO IMPROVE LIBRARY SERVICES

Now electronic information resources are introduced in libraries. So, library users seek new possibilities for obtaining information. If the library provides remote access to the database, it becomes more physically accessible to the library users. Only by conducting user studies librarians can take the necessary decisions to move to electronic resources. It is only possible by gathering library users, their interaction with library services and the materials used. Recommendations of various user studies may be applied to improve library operations. It is to be noted that certain libraries may need special attention. Some prominent studies are discussed below to help LIS professionals as the basis of decision-making in libraries. The first way to use these research results is as the basis of decision-making in the library. For example, the result of **Johnson's** (2002) study could be used to plan the timing of a library's implementation of online chat reference services, and that to develop a programme for marketing those services. Both **Kuhlthau's** (1990) and **Cool's** (1993) results could have been used to develop some in-service training for reference librarians on how to augment their typical reference interviews.

The second way is to use this evidence to influence the vendors of online searching systems or the publishers of other library resources. **Wildemuth** and **Moore** (1995) suggested ways to improve vocabulary support that could be implemented by online vendors. The third way is to use the evidence you have gathered to support your own development of library systems, either for an individual library or for consortium libraries. **Wildemuth** et al. (2002) have led us in this direction. While such development projects may stretch the resources available in individual libraries, they have the potential to advance the practice of librarianship across multiple libraries.

13.8. SUMMARY

In this module, an attempt has been made to explain and discuss the concept of user studies and its recent trends in the digital era. User studies and user data are essential to system analysis. User information is an important part of the measurement and evaluation of library services. It is also helpful for the planning of libraries. Libraries and information centres are so far from, being models of efficiency in their organisational and delivery systems. Several criticisms against user studies are as follows: lack of proper selection of population or universe, over generalisation, lack of proper analysis, and diverse classification of communication channels Because of the above-mentioned criticism, several information scientists doubted the credibility of user studies. But now modern techniques including statistical analysis by using computers have accounted for a change in the situation.

In spite of this, it can't be said for certain that user studies are flawless. Library and information science changed the world of the information environment called the information age or digital age. In the early 21st century due to the rapid growth of information technology, libraries were not going back to control. Now user studies have become an important area of information science and developing into a branch of information science. To these results, user studies and information retrieval are becoming close. The gap between information seeking, information retrieval and information services is becoming narrow because important themes are emerging in user studies.

13.9. MCQ QUESTIONS

1. Pilot Study on the use of Scientific Literature by Scientists conducted by: A. Herbert Menzel B. Ralph R. Shaw C. T. D. Wilson D. S. R. Ranganathan

2. Which term is a not synonym for user study? A. User Survey B. Library Survey C. Information Use Behaviour D. Information System

3. In the earlier stage of user study was mainly related to _______ A. Librarians B. Scientists C. Publishers D. Information officers

4. The upcoming trend in user study as a result of technology/ Information advances in the economics of information systems. __________

5. Now traditional information sources/ electronic resources are introduced in libraries. So, library users seek new/old possibilities for obtaining information. ________

6. A number of user studies set out to investigate a multiplicity of issues concerning the impact of the internet on the use and the information community. True/False

7. Action research and qualitative research are not appropriate methodologies for the study of human information behaviour. True/False

8. User studies are moving into a mature generation by building on earlier foundation research. True/False

13.10. SHORT QUESTIONS

What are the methods of user studies?

What are the different techniques of user studies?

What is an information user study?

What are the benefits of user studies in the library?

13.11. LONG QUESTIONS

Why do we need user education services in the library?

What are the categories of information users?

KEYWORDS: User study; Methods of user studies; Categories of information users

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UNIT 14

INFORMATION LITERACY: DEFINITION, OBJECTIVES AND IMPORTANCE

14.0. OBJECTIVES

The objectives are: information literacy: definition, objectives and importance

14.1. OUTCOME OF LEARNING

After reading this unit, you will be able to gain, to provide basic understanding of the Information Literacy concept and its importance

14.2. STRUCTURE OF UNIT

- Introduction
- Definition
- Concept
- Objectives of Information Literacy
- Importance
- Summary
- References

14.3. INTRODUCTION

The term information literacy first appeared in print in a 1974 report by Paul G. Zurkowski. It was written on behalf of the National Commission on Libraries and Information Science. Zurkowski used the phrase to describe the "techniques and skills" known by the information literate "for utilizing the wide range of information tools as well as primary sources in finding information solutions to their problems (Zurkowaski, 1974). Information literacy has been known by many different names: library orientation; bibliographic instruction; user education; information skills training. There is considerable degree of overlapping in the meaning of these terms. Library orientation concentrates on how to make optimum use of library resources; and bibliographic instruction and user education focuses on the mechanics of using particular resources.

Information skills training and finally information literacy concentrates on cognitive and transferable skills, such as problem solving, evaluation and communication skills. We often confuse information literacy with information management. Many associate it with accessing online information. There are people who associate information literacy with library & research skills. In general, the information literacy in the layman's language is the ability to find, understand, evaluate and use information in various forms to create for personal, social or global purpose.

14.4. DEFINITION

The United States National Forum on Information Literacy defines information literacy as " ... the ability to know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand." Other definitions incorporate aspects of "skepticism, judgment, free thinking, questioning, and understanding..." or incorporate competencies that an informed citizen of an information society ought to possess to participate intelligently and actively in that society.
In UK, information literacy is defined by the Chartered Institute of Library and Information Professionals as: "Information literacy is knowing when and why you need information, where to find it, and how to evaluate, use and communicate it in an ethical manner." ALA defined information literacy as "set of abilities that enables an individual to recognize when information is needed and have the ability to effectively locate, evaluate and use the needed information."
According to ACRL, Information Literacy is the set of skills needed to find, retrieve, analyse and use information. Shapiro and Hughes (1996) have defined information literacy as "… a new liberal art that extends from knowing how to use information to critical reflection on the nature of information itself, its technical infrastructure, and its social, cultural and even philosophical context and impact."

14.5. WHAT DOES IT MEAN TO BE INFORMATION LITERATE?

- Becoming a lifelong learner
- Using the library effectively
- Understanding what you read
- Using information wisely
- Organising resources
- Developing ideas
- Using IT
- Knowing where to look
- Interpreting, summarizing
- Understanding how information works.

Further definitions have expanded on the theme, broadening the scope "...to address issues or problems at hand that face individuals, communities, and nation" (Thompson, 2003, p3); "...knowing when and why you need information, where to find it, and how to evaluate, use and communicate it in an ethical manner" (CILIP, 2004). Early definitions of Information literacy has led to the identification of a list of attributes or competencies an information literate person is supposed to exhibit, for example an information literate individual requires an understanding of:

- A need for information
- The resources available
- How to find information
- The need to evaluate results
- How to work with or exploit results
- Ethics and responsibility of use
- How to communicate or share findings
- How to manage findings.

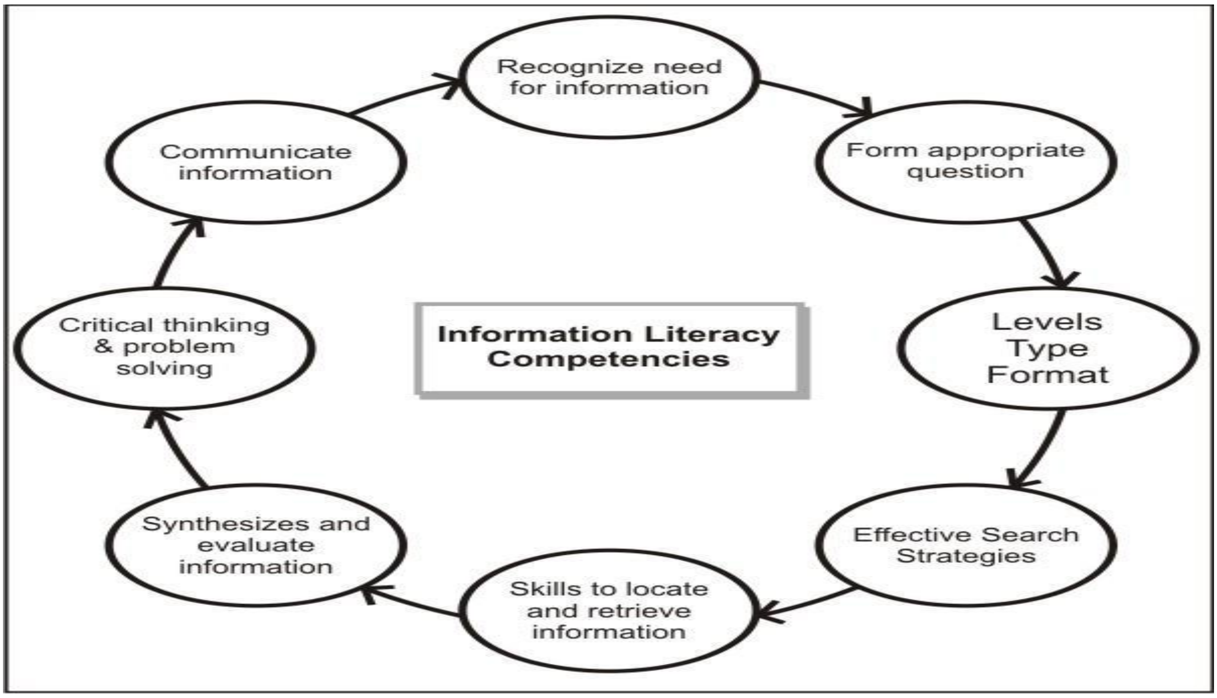
14.6. CONCEPT

A number of efforts have been made to define the concept of information literacy and its relationship to other skills and forms of literacy. Although other educational goals, including traditional literacy, computer literacy,library skills, and critical thinking skills, are related to information literacy and important foundations for its development, information literacy itself is emerging as a distinct skill set and a necessary key to one's social and economic well-being in an increasingly complex information society.

Shapiro and Hughes (1996) outlined a "prototype curriculum " that encompassed the concepts of computer literacy, library skills, and "a broader, critical conception of a more humanistic sort", suggesting seven important components of a holistic approach to information literacy:

- **Tool literacy**, or the ability to understand and use the practical and conceptual tools of current information technology relevant to education and the areas of work and professional life that the individual expects to inhabit.
- **Resource literacy**, or the ability to understand the form, format, location and access methods of information resources, especially daily expanding networked information resources.
- **Social-structural literacy**, or understanding how information is socially situated and produced.
- **Research literacy**, or the ability to understand and use the IT-based tools relevant to the work of today's researcher and scholar.
- **Publishing literacy**, or the ability to format and publish research and ideas electronically, in textual and multimedia forms ... to introduce them into the electronic public realm and the electronic community of scholars.
- **Emerging technology literacy**, or the ability to continuously adapt to, understand, evaluate and make use of the continually emerging innovations in information technology so as not to be a prisoner of prior tools and resources, and to make intelligent decisions about the adoption of new ones.
- **Critical literacy**, or the ability to evaluate critically the intellectual, human and social strengths and weaknesses, potentials and limits, benefits and costs of information technologies.

There are diverse views as to what constitutes information literacy, scholars have tried to explain information literacy in terms of certain competencies as evident from the diagram given below.



The scholars have tried to describe the concept of Information Literacy in terms of the following:

- Finding information conception – with an emphasis on gathering information, mainly facts, using technology and the library, and the need for students to be able to navigate different sources, such as websites, books, the library.
- Linguistic understanding conception – basic comprehension of textual or verbal information, including instructions for a particular activity, relying to an extent on general knowledge and prior experiences in similar activities.
- Making meaning conception – cognitive processes, for example summarising, synthesising, interpreting, decision-making, which make sense of, or derive meaning from, information in different sources and formats within the context of the specific subject under consideration.
- Skills conception – practical ability to apply effectively a wide variety of skills, techniques and strategies required for handling information, including traditional library and information skills and more cognitive skills required for making meaning and evaluating and reflecting on decisions.
- Critical awareness of sources conception – focusing on the need to evaluate sources, recognise bias, determine the quality of the information and check the authority of a website.
- Independent learning conception – the ability to confidently make decisions in order to assess, select and apply relevant skills and strategies for current purpose in and in a variety of situations, in order to learning independently, with less reliance on teacher input.

14.7. OBJECTIVES OF INFORMATION LITERACY

The main objectives of information literacy programme is to make the individual proficient in the optimum, effective and judicious use of information for not only enhancing the understanding but productive utilization of information resources. In other words the main focus is on making the people information literate through the infusion of information literacy skills.

14.8. IMPORTANCE

Research shows that people evaluate more effectively if causes are revealed, where available. Such initiatives would help people become more information literate. As a society, we must critically evaluate information to establish a public demand for high information quality. Information literacy skills are vital because:

- Information literacy skills must be taught in the context of the overall process.
- Instruction in information literacy skills must be integrated into the curriculum and reinforced both within and outside of the educational setting.

14.9. SUMMARY

Now the information literacy has become a part of the core curriculum in many universities particularly in developed countries. The information overload and the need to search and retrieve correct and reliable information from different sources and channels compels the people to be information literate. This calls for information literacy programmes in the form of courses or training to be imparted to people by different agencies including libraries. The information literacy skills are to be developed to make the people information literate. In the present digital age, the users need to be more information literate than before. Though Internet is expected to contains valid and accurate information, its very nature encourages quick and easy self publication without any review, content is also of low quality and there is need for the user to be able to recognize and access authentic and useful resources. There is a need to be able to analyse and evaluate information sources, retrieve for value, relevance, quality and suitability. The information literacy helps the individual to acquire and develop the skills. The skills of critical thinking, research and evaluation are increasingly required to make sense of the world.

14.10. MCQ QUESTIONS

1. Information Literacy was introduced by:-A. Kuhlthau B. Paul G. Zurkowski C. McKenzie D. Peter Clinton

2. How many stages are involved in Kuhlthau model? Six Stages

3. Who has develoed information literacy model “The Research Cycle”? A. Kuhlthau B. Christine Susan Bruce C. Sandra Hughes D. McKenzie

4. Which model is based on the philosophy of “different faces of information literacy at workplaces”? A. Seven Faces of Information Literacy B. Jamie McKenzie’s Model of Information Literacy C. The 8 W’s Literacy Model D. Search Process Model

5. Which model was developed by James Herring A. Seven Faces of Information Literacy B. Plus Model C. The 8 W’s Literacy Model D. Search Process Model

6. PLUS model represents A. Purpose, Location, Use and Self-evaluation B. Plan, Locate, Use, Satisfaction C. Progress, Liability, Utility, Satisfaction D. Planning, Locating, Utilizing, Satisfying

7. Which model involves Main Stages and Sub-Stages? A. Big6 Skills B. PLUS Model C. Sauce Model D. Jamie McKenzie's Model

8. Sauce Model of Information Literacy was initially developed in the year. _________

9. Information Literacy was introduced by :-A. Kuhlthau B. Paul G. Zurkowski C. McKenzie D. Peter Clinton

10. How many stages are involved in Kuhlthau model? _________

11. Who has develoed information literacy model "The Research Cycle"? A. Kuhlthau B. Christine Susan Bruce C. Sandra Hughes D. McKenzie

12. Which model is based on the philosophy of "different faces of information literacy at workplaces"? A. Seven Faces of Information Literacy B. Jamie McKenzie's Model of Information Literacy C. The 8 W's Literacy Model D. Search Process Model

13. Which model was developed by James Herring A. Seven Faces of Information Literacy B. Plus Model C. The 8 W's Literacy Model D. Search Process Model

14. PLUS model represents A. Purpose, Location, Use and Self-evaluation B. Plan, Locate, Use, Satisfaction C. Progress, Liability, Utility, Satisfaction D. Planning, Locating, Utilizing, Satisfying

15. Which model involves Main Stages and Sub-Stages? A. Big6 Skills B. PLUS Model C. Sauce Model D. Jamie McKenzie's Model

16. Is information literacy necessary in the age of ICT? True/False

17. Are all modules of Information literacy taught Information Literacy and also how to use Library Resources? True/False

18. Sauce Model of Information Literacy was initially developed in the year. ______

19. Information literacy includes which five essential elements: A. Perception, Speaking and learning, Reading and writing, Broadcast, Inform. B. Basic Learning, Library Literacy, Media Literacy, Technology Literacy, Visual Literacy C. Social responsibility, Independent learning, User education, User participation, Teaching mechanics D. None of the above

20. CILIP stands for: A. Institute of and Information Professionals B. Chartered Institute of Library and Information Party C. Chartered Institute of Liberty and Info Professionals D. Chartered Institute of Library and Information Professionals

14.11. SHORT QUESTIONS

What is the 5 key concept of information literacy?

What do you understand by Tool literacy?

What do you understand by publishing literacy?

Mention three objectives of information literacy.

14.12. LONG QUESTIONS

Write two importance of Information literacy.

What are the five components of information literacy?

What is the significance of information literacy?

KEYWORDS: Information literacy; Objectives information literacy

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UNIT 15

INFORMATION LITERACY 2.0

15.0. OBJECTIVES

The objectives are: Information Literacy, Various models of Information Literacy, E-learning, Hybrid Learning

15.1. OUTCOME OF LEARNING

After reading this unit, to gain detailed knowledge on Information Literacy, Web 2.0 Tools

15.2. STRUCTURE OF UNIT

- Introduction
- Defining Information Literacy (IL)
- Redefining Information Literacy: A smooth Transition to Information Literacy (IL) 2.0
- What is Web 2.0
- Web 2.0 and Information Literacy (IL)

- Summary
- References

15.3. INTRODUCTION

The advance of participatory technologies and Web 2.0 has modified the surroundings in which people access information and build knowledge. Web 2.0 tools allow people to be both consumers and producers of information, a fact that influences both teaching and learning. These participatory technologies enable reflective learning, independent learning, and the building of learning communities (Aharony & Bronstein, 2014). In the present context, libraries are already offering Information Literacy services that are constructed around the ideas of participatory service and Web 2.0 technologies (Humrickhouse, 2011). This module is designed to highlight several components such as definitions of Information Literacy, Information Literacy 2.0, Web 2.0 and the relation between Web 2.0 and Information Literacy. The topics and sub-topics of the module have especially focused on the evolution and expansion of the concept of Information Literacy, Information literacy 2.0, web 2.0 and its principles.

15.3.1. Defining Information Literacy (IL)

There are numerous definitions which are extensively acknowledged in discussing and illustrating information literacy. CILIP (Chartered Institute of Library and Information Professionals) defined it as "knowing when and why you need information, knowing where to find it, and how to evaluate, use and communicate it in an ethical manner." The Information literate person should have the following skills:

- A need for information.
- The resources available.
- How to find information.
- The need to evaluate results.
- How to work with or exploit results.
- Ethics and responsibility of use.
- How to communicate or share your findings.
- How to manage your findings. (Chartered Institute of Library and Information Professionals, 2014)

According to the Association of College and Research Libraries (2014a), "Information Literacy is the set of skills needed to find, retrieve, analyze, and use information." "It is a survival skill in the Information Age. Instead of drowning in the abundance of information that floods their lives, information-literate people know how to find, evaluate, and use information effectively to solve a particular problem or make a decision. To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information. (Association of College and Research Libraries, 2014b)."

"Being Information literate ultimately improves our quality of life as we make informed decisions when buying a house, choosing a school, hiring staff, making an investment, voting for our representatives, and so much more (Association of College and Research Libraries, 2014a)." "Ultimately, information literate people are those who have learned how to learn. They know how to learn because they know how knowledge is organized, how to find information, and how to use information in such a way that others can learn from them.

They are people prepared for lifelong learning because they can always find the information needed for any task or decision at hand. Thus, Information Literacy is, in fact, the basis of a sound democracy. (Association of College and Research Libraries, 2014b)." IFLA's Information literacy section was established to foster international cooperation in the development of information literacy education in all types of libraries and information institutions. IFLA's guidelines on Information literacy and Lifelong learning define Information literacy as a term which is commonly used in the English-speaking world to denominate information competencies that imply the capacity to identify when information is needed, and the competence and skill to locate, evaluate and use information effectively. In Spanish, the meaning of information literacy implies the basic school skills of reading and writing. Literacy is a term used by ministries of education to call the basic teaching of reading and writing, but not necessarily of learning to learn. The preferred term, therefore, is the development of information competencies, at least from the Spanish language point of view.

Sheila Webber (2010) defines information literacy as the adoption of appropriate information behavior to identify, through whatever channel or medium information well fitted to information needs, leading to the wise and ethical use of information in society. She also recommends an agenda for Information literacy education:

- IL as context-specific and context sensitive;
- IL demands a variety of behaviors, such as, not just searching, but also encountering, browsing,
- monitoring, managing and creating;
- People moving along complex paths to meet their information needs: moving between the virtual and physical worlds, and using different sources and spaces;
- IL in digital environments;
- IL with people sources;
- People being information literate individually and collaboratively;

People being aware they are information literate: you cannot be an information literate 21st Century citizen without being conscious of the need to develop these IL skills and attitudes, and continue to update your IL throughout your life!

15.4. REDEFINING INFORMATION LITERACY: A SMOOTH TRANSITION TO INFORMATION LITERACY (IL) 2.0

Since there are several aspects of information literacy thus it is not possible to provide an impermeable definition of Information Literacy 2.0. Precisely, "IL 2.0 is not a monolithic whole that could be standardized and objectively measured. There is not just one "right and correct" IL 2.0 but many kinds of literacies that can be practised both collectively and individually. The publishing and information culture of a certain discipline, like law, is not domain-independent but domain-specific. There is no one correct way to practice information skills and only the most general IL "rules" apply equally well to all knowledge domains. IL 2.0 is both a group phenomenon and something taking place in the mind. Web 2.0 technologies give us new means to practice and educate collective and dialogical information creating, seeking and managing skills (Tuominen, 2007). "

IL 2.0 is defined as one of the subsets of IL. IL 2.0 calls for broadening of the concept through the inclusion of information spaces that have been brought about by Web 2.0, such as Wikipedia, blogs, social bookmarking services etc. These spaces may well enough be used for research and educational purposes. As presented in figure 1, there is a gradual widening of focus from stable and structured spaces towards the inclusion of those that are mutable and unstructured, but there is no sharp dividing line drawn between the spaces included in IL and IL 2.0 programs (Spiranec & Zorica, 2010).

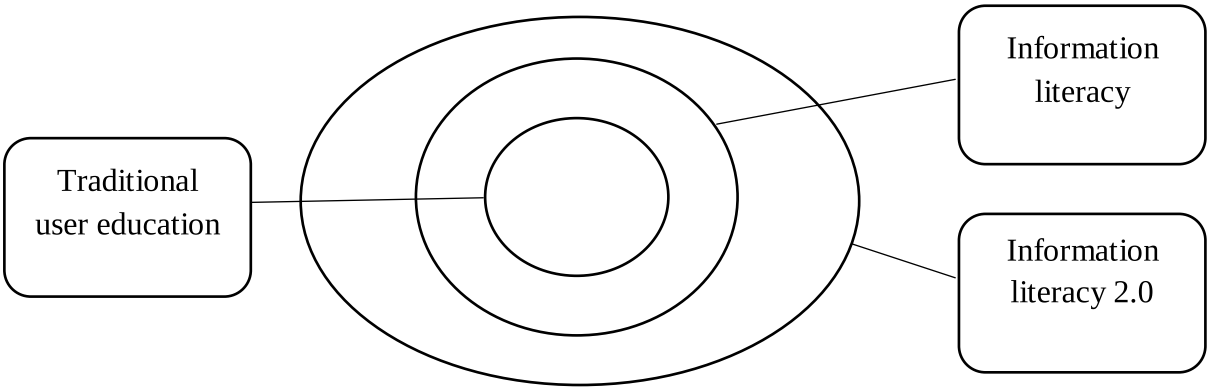

Figure 1: Widening of information landscapes included in IL 2.0 programs

According to Spiranec & Zorica (2010), "IL 2.0 is entirely about using Web 2.0 services in information literacy training and activities i.e. as a medium of information delivery and a method of education. This means that in order to be able to provide information literacy training, librarians and teachers have to use Web 2.0 services and applications, not as isolated tools, but within their IL programs and sessions. This in turn is closely related to the necessity for creating IL programs that will meet the demands of the real world, programs that will address a real audience. It is also observed that web 2.0 services are becoming an important part of many aspects of users' lives. By ignoring these services, information literacy experts will not share the same place with students, teachers and clients, and their efforts will be significantly limited in range. Nevertheless, bearing in mind the dramatic impact of Web 2.0 on central conceptions of IL, it would be limiting to equate Information literacy 2.0 with the use of new technology in information literacy training." Hence Information literacy 2.0 should include the range of shifts summarized in Table I (Spiranec & Zorica, 2010).

Table 1: Contrasting features of library user education, information literacy and information literacy 2.0

Contrastive categories	User education	Information literacy	Information Literacy 2.0
Accents in teaching	Teaching mechanics	Teaching concepts and strategies	Interpretations, Negotiations
Content	Access and retrieval (Library and resource-based approach)	Access and retrieval (Boolean operators, truncation, controlled vocabularies etc.) + evaluation	Recognizing Information contexts, addressing authority, reliability and accuracy issues
Characteristics of programs	Exclusivity of Solutions ("single correct solutions")	Exclusivity of solutions and preferable information paths	Non-exclusive solutions, multiple information paths
Perception of Information system	Systems-level: objective	Systems-level: objective	Personnel level: subjective
Perception of Information spaces	Structured library	Structured information landscapes	Information spaces of unorganized structures

	world		
Perception of users	Educating library users	Educating information users	Educating information users + creators
Methodologies	One-time sessions, isolated instruction, direct teaching, rarely integrated	Add-ons or integrated, elearning and hybrid teaching and learning environments	Add-ons or integrated, e-learning and hybrid environments, web 2.0 services

Additionally, according to Hapke (2007), Information Literacy 2.0 is seen as a cerebral experience where informal learning is an integral component. “IL 2.0 includes not only learning with information but learning about information and knowledge. It challenges the library-based concept of information literacy. In the world of web 2.0, the user is seen not as a customer, but as a co-producer; education is not a transfer of information and knowledge but a process to create an ability of reflection and critical awareness; the library is not a warehouse of information but a place for individual and collaborative experiences and learning.

15.4. WHAT IS WEB 2.0

A term coined by Tim O’ Reilly of O’ Reilly Media (2005), Web 2.0 describes "the changing trends in the use of World Wide Web technology and Web design that aim to enhance creativity, communications, secure information sharing, collaboration and functionality of the Web.” “The essence of Web 2.0, or the read /write Web, is participation in creating information dynamically, whereas the earlier phase of the Web, or the read /only Web, primarily focused on presenting information statically. Two prominent characteristics of Web 2.0 technologies are multi-way communication and collaborative information creation/ retrieval (Luo, 2010).”

Further, “It is a technology shifting the Web to turn it into a participatory platform, in which people not only consume content (via downloading) but also contribute and produce new content (via uploading). Web 2.0 ideas incorporate new techniques (tagging, blogs, wikis, mashups), which are breaking the barriers between users and data-providers, by creating new and useful links among them (Darwsih & Lakhtaria, 2011).”

Moreover, it was also noted that “over the years, two defining elements have emerged from Web 2.0. The first is that Web 2.0 is a platform, with applications and files stored on the Web rather than on a user’s desktop; in this arrangement, software is a service (and often a free service) rather than a product. The second defining element of Web 2.0 is participation; the Web is now the participatory Web, the social Web, the read-write Web. We see this as personal activities in Wikipedia, YouTube, Facebook, blogs, video sharing, podcast, and elsewhere as in Figure 3. The idea is that the Web harnesses collective intelligence and empowers users through the formation of communities and the mass publication of user-generated content (Darwsih & Lakhtaria, 2011).”

Figure 2: Some Web 2.0 personal activities tools

Further, Web 2.0 refers to a perceived second generation of web development and design that facilitates communication, secure information sharing, interoperability, and collaboration on the World Wide Web. Moreover, the term Web 2.0 is often applied to a heterogeneous mix of relatively familiar and also very emergent technologies. Social media has become extremely popular as it allows people to connect in the online world to form relationships for personal and business. The term most often refers to activities that integrate technology, social interaction, and the construction of words, pictures, videos and audio. Most of these tools started as business applications and were designed for real-time communication before finding
their ways to education, learning and every sphere of human endeavour (Olasina, 2011).

Examples of such technologies include social networking sites (e.g. Facebook), video sharing sites (e.g. YouTube), wikis, blogs, and social bookmarking sites (e.g. del.icio.us) (Luo, 2010). Chad and Miller (2005) argued that it is important that libraries should begin to use these Web 2.0 tools if they are to prove themselves to be just as relevant as other information providers; they should also start to deliver experiences that meet the modern user's expectations. Miller (2005) further envisioned the principles of Web 2.0 as:

- Web 2.0 presages a freeing of data.
- Web 2.0 permits the building of virtual applications.
- Web 2.0 is participative.
- Web 2.0 applications work for the user.
- Web 2.0 applications are modular.
- Web 2.0 is about sharing.
- Web 2.0 is about communication and facilitating community.
- Web 2.0 is about remixing.
- Web 2.0 is smart.
- Web 2.0 opens up the Long Tail.
- Web 2.0 is built upon Trust.

15.5. WEB 2.0 AND INFORMATION LITERACY (IL)

Traditionally, IL instructions in libraries have been about how to use the library, how to access databases, and how to find books and journal articles in the OPAC. Today we have more opportunities and responsibilities to instruct our patrons in the use of Web 2.0 tools in terms of scholarly and authoritative research. Librarians today can help the user improve their Information Literacy skills by using tools with which the students are most comfortable

(Humrickhouse, 2011). The connection between IL and Web 2.0 would widen the existing literature.

This connection is about: the librarian's own knowledge and abilities, connection with a new type of user, content which we could use as teachers, content for users to employ in their study, or to reach the so-called Web generation or all users (Godwin, 2009). Thus, Web 2.0 librarians should help their patrons understand how to use a Web 2.0 tool as a starting point and how to move their search fluidly from there into a library database. The most important responsibility of the Web 2.0 librarian may not be to teach Information Literacy, but rather to build upon and refine the skills that users already have (Humrick house, 2011). The various Web 2.0 tools that can be considered as means for teaching information literacy may take the forms of blogs, photo-sharing and video-sharing, tagging and bookmarking sites as well as social networks. According to the white paper issued by Taylor Francis (2014), Godwin (2007) and Lapuz (2009), the commonly used Web 2.0 tools used by librarians in teaching information literacy are:

Web 2.0 Tools	Uses in teaching Information Literacy
Twitter	Distribute library news and information Provide customer service Build connections withresearchers Build connections with other librarians and institutions
Facebook	Distribute library news and information More social and less formal than Twitter – share photographs and run competitions Arrange events including tracking RSVPs and sending event updates Engagement with students,answering questions and providing information about library services. For dents, tagging can become part of critical thinking, creating links which involve evaluation, categorizing and formulating keywords.
Pinterest	Promote general library collections, digital and archive special collections and information literacy Set up online repositories for students to pin researched references as part of collaborative group work Display book titles to savetime browsing and promote new titles Develop communities with other online libraries
You Tube	Streaming film collections Instructional 'howto videos teaching information literacy skills and how to use library services and resources The library can create its own videos for promotional programmes and tutorials on how to access library databases and other relevant resources and upload them on YouTube for the IL class. Librarians and faculty can use videos to illustrate points in class / IL class and to get students' attention (Luo, 2010, p.36).
Blog	All types of libraries use blogs to create "What's New" for users to market new materials and resources, and events and to share information. Open comments create conversation within the community Aid the students to develop writing skills, and encourage the creation of communities and reflections Can be used in teaching with student content being collected into the teachers' aggregators Keeping a blog as a way of recording progress andmanaging time Can be used to build up evidence and gather opinions from peers orinstructors
Instant Messaging	IM provides inexpensive virtual reference through which patrons can synchronously communicate with librarians much as they would in a face-to-face reference context.

	It allows a user presence within the library web-presence; it allows collaboration between patrons and librarians (Maness, 2006)
Wiki	A good starting point for research Encourage group work and peer review A good way to introduce how easy it is to be creating and posting information on the web. Students can use a wiki to develop research projects the wiki acts as ongoing documentation of their work (Luo, 2010, p.35). Wikis can be used to facilitate a presentation in place of conventional software (Luo, 2010). Librarians can annotate all of their online and print resources; they can allow easy access to the site by staff, students, and the librarians themselves (Stephens & Collins, 2007). Librarians can create a subject guide for their users and allow them to discuss and suggest additions to such pages; librarians can edit the pages via the wiki interface (Stephens & Collins, 2007). Faculty can use wikis to disseminate knowledge, to facilitate active learning by designing collaborative activities, reflective assignments, individual and group problem solving and challenging and innovative assessment projects and assignments (Niedbala & Fogleman, 2010)
RSS feeds	RSS is about convenience and is at the heart of Web2.0 (Godwin, 2009, p. 269). It allows the regular update of chosen information or content to the users which then comes automatically to them, keeping them up to date.
Podcasts	Librarians can use podcasts for library instruction, especially for distance learners. They allow students to time-shift which is useful while in a car while jogging or anywhere. Libraries can offer podcasts of promotional recordings about the library's services and programs, such as Recordings of book reviews for all ages, speeches by visiting authors, children's storytimes, and book club promotions (Stephens & Collins, 2007, p. 255). Libraries can also offer podcasts of new resources, library information and tour of libraries (Stephens & Collins, 2007, p. 255).
Social Bookmarking Sites	Social bookmarking sites provide ways for users to store and organize Web pages with tags or describing keywords. They also allow users to make use of other people's tags while searching for specific information. These are used for the purposes of online research. Instructors can use social bookmarking sites to save helpful Web resources, search for other Web resources with similar tags and share those resources with students and other instructors (Luo, 2010, p. 35). Some social bookmarking sites are del.icio.us, diigo.com, portaportal.com, CiteULike, and Iibrarything.com. Del.icio.us can be used as a research tool to help students to organise what they find and bookmark easily, accessible anywhere. It can assist with referencing and encourages them to tag, which is central to the linking of ideas, and aids sharing of resources. CiteULike enables easy tagging and sharing of bibliographic information (Godwin, 2009, p. 270). LibraryThing enables the storage of details about books which have been read. (i.e. cataloguing); brief descriptions, reviews and tags can be constructed; the information can then be shared with others who have read the book. This would foster alternative and additional reading, based on their opinions and favourites. This could be used with groups of students to encourage reading, sharing of favourites and critical review.

15.6. SUMMARY

Today, a Web 2.0 library is a reality. With the prevalence of Web 2.0, its value is being recognized as a medium to facilitate Information Literacy Instructions (Luo, 2010). "The landscape of Web 2.0 is constantly evolving and it is crucial that librarians stay current with its development and be able to identify the tools that are useful in information literacy instructions. Reading the published literature, following professional blogs and tweeter messages, communicating with colleagues, and attending conferences are helpful measures that librarians can take to keep abreast of the rapidly developing technology (Luo, 2010)." Moreover, librarians should be willing to explore the various Web 2.0 tools and examine their possible application in teaching and learning. They also need to cultivate a keen sense of students' needs so as to choose the proper tools to use in the most fitting context (Luo, 2010). Since it's a world of perpetual beta, so librarians should trial Web 2.0 tools in order to connect to the so-called Net Generation and help this generation to develop a sense of context when using information, guiding them towards assimilations, deep thinking and reflection (Godwin, 2007).

MCQ QUESTIONS

1. Web 2.0 is A. Read / Write Web B. Read-only web C. Write only web D. World Wide Web

2. What are the tools of Web 2.0 A. Twitter B. Youtube C. Facebook D. all of the above

3. Which tool of Web 2.0 provides ways for the user to store and organize web pages with tags or describe keywords? A. RSS feed B. Podcast C. Social Bookmarking sites D. Twitter

4. Through………………library can create its own videos for promotional programmes and tutorials on how to access library databases and other relevant resources. A. Blog B. Twitter C. Pinterest D. YouTube

5. ___________ provides inexpensive virtual reference through which patrons can synchronously communicate with librarians. A. Pinterest B. Instant Messaging C. wiki D. You tube

6. Information literacy 2.0 is a subset of A. Information Literacy B. user education C. Web 2.0D. Internet

7. In the world of web 2.0 user is seen as a: A. customer B. student C. Co-producer D. Publisher

8. E-learning plays an important part in information literacy 2.0. True/False

9. Web 2.0 technologies are collaborative information creation/retrieval. True/False

10. Web 2.0 technologies are single-way communication. True/False

11. Web 2.0 application is a 'long tail' phenomenon. True/False

12. Web 2.0 applications are non – modular. True/False

13. Relief/ Satisfaction or disappointment is associated with which model: A. Robert S. Taylor B. Brenda Dervin C. Carol Kuhlthau D. None of these

14. Who first explained that “information-seeking behavior begins when someone realizes the existence of an information need and ends when that need is believed to have been satisfied”. A. Wilson B. Krieklas C. Hanson D. Eliss

15. Following references (backwards) or citations (forward) for additional information in Elis’s model is related to A. Stating B. Accessing C. Chaining D. Ending

16. The book Being Digital is written by whom? A. Nicholas Negroponte B. Chris Hanson C. B. Eliss D. T.D. Wilson

17, Caroline Kuhlthau's information search model, identifies _________ stages of the information search process.

18. Infolibrarian is an example of: A. Database B. Search Engine C. Online Journal D. Subject Gateway

19. What types of information seekers can seek from Web of Science A. Full-text journal B. Bibliographic data C. Citation data D. all of the above

20. Greenstone and D-Space are the examples of A. Digital Library Software B. ILMSC. Bibliographic Control D. None

15.7. SHORT QUESTIONS

What is WEB 2.0?

What is information literacy and why is it important?

What is web-based information literacy?

What are some examples of information literacy?

15.8. LONG QUESTIONS

Write down two uses of Twitter in teaching information literacy.

What are the 6 types of information literacy?

What impact does Web 2.0 technology have on education?

KEYWORDS: WEB 2.0; Information literacy; Web-based information literacy

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ANSWERS

UNIT 1

INTRODUCTION TO USER STUDIES

1. **C. Nicholas J Belkin**
2. **D. James Krikelas**
3. **B. Centre for Research on the United States**.
4. **Four**
5. **C. The American Psychological Association (APA)**.
6. **C. information retrieval**,
7. **A. current state of knowledge**

8.. **True**

9. **False**
10. **False**
11. **Approximately 119**
12. **D. All of the above**.
13. **A. (both published and unpublished)**
14. **D. All the above.**
15. **A. Cooper**
16. **C. Bruce**.
17. **A. Full-text bibliographic database**
18. **B. Library and Information Service & Technology Abstracts**
19. **A. Library and Information Science Abstracts**
20. **C. abstracting and indexing**

UNIT 2

EVOLUTION OF USER STUDIES

1. **D. S R Ranganathan**
2. **1930's**
3. **A. R R Shaw**
4. **C. Information priorities of the user**
5. **D. All of these**

6. **A. Belkin**
7. **Six Stages**
8. **1975**
9. **C. Impact of the Internet on users**
10. **D. CLIR**
11. **150 core titles**
12. **Approximately 119**
13. **D. All of the above**.
14. **A. both published and unpublished**
15. **D. All the above.**
16. **C. Bruce**
17. **A. Full-text bibliographic database**
18. **A. Library, Information Science & Technology Abstracts**
19. **A. Library and Information Science Abstracts**
20. **C. abstracting and indexing**

UNIT 3

REVIEW OF LITERATURE

1. **Approximately 119**
2. **D. All of the above**.
3. **A. both published and unpublished**
4. **D. All the above.**
5. **A. Cooper**
6. **C. Bruce**
7. **A. Full-text bibliographic database**
8. **B. Library and Information Service & Technology Abstracts**
9. **A. Library and Information Science Abstracts**
10. **C. abstracting and indexing**
11. **150 core titles**
12. **Approximately 119**
13. **D. All of the above**.
14. **A. both published and unpublished**
15. **D. All the above.**
16. **A. Cooper**

17. **C. Bruce**

18. **A. Full-text bibliographic database**

19. **A. Library, Information Science & Technology Abstracts**

20. **A. Library and Information Science Abstracts**

UNIT 4

CATEGORIES OF USERS

1. **B. Readers, Reading materials and Library personnel**
2. **D. Harrod Librarians Glossary and Reference Book**
3. **A. Borrower**
4. **B. Mahatma Gandhi**
5. **B. Readers, Reading materials and Library personnel**
6. **D. Harrod's Librarians' Glossary and Reference Book**
7. **A. Borrower**
8. **B. Mahatma Gandhi**
9. **B. Information Communication Technology**
10. **Broker**
11. **C. Business Dictionary**
12. **C. Online Publicly Access Catalogue**

14. **Virtual Library**

15. A. IndCat

16. **University of Michigan**

17. B. Annual Report of the concerned Ministry/Department

18. **False**

19. C. Community Survey

20. **B. Circulation Transactions**

UNIT 5

IDENTIFYING OF USER INFORMATION NEEDS

1. **A. N J Belkin**
2. **C. T D Wilson**
3. **C. R S Taylor**
4. **B. Generating need-based information services**

5. **Internet and Google**

6. **cognitive**

7. **D. information-seeking behavior**

8. **True**

9. **False**

10. **True**

11. **Association of College and Research Libraries**

12. **Institutional Repositories**

13. **Directory of Open Access Journals**

14. **PLoS**

15. **Protocol**

16. **Centre for Research Communications (CRC)**

17. **electronic theses and dissertations**

18. **Preprints**

19. **False**

20. **False**

UNIT 6

ASSESSMENT OF INFORMATION NEEDS OF DIFFERENT USER GROUPS

1. **B. Knowledge**

2. **A. Weisman**

3. **D. Paisley**

4. **A. idea, theories and hypotheses about the relationship**

5. **A. Physiological motives**

6. **A. The matter and energy**

7. **B. Bernal**

8. **B. Weigts et al**

6. **C. Heuristic Evaluation**

7. **A. First-time user**

8. **B. Scenario-based Design**

9. **C. Conventional and Non-Conventional**

10. **A. Methodology**

11. **A period of time**

12. **B. Behaviour**
13. **Six**
14. **C. Discussion**
15. **A. Interactive**
16. **C. Association of College and Research Libraries**
17. **B. Information literacy**
18. **False**
19. **True**
20. **True**

UNIT 7

METHODS AND TECHNIQUES OF USER STUDIES PART- 1
METHODS AND TECHNIQUES OF USER STUDIES PART- 2

1. **A. Regularly**
2. **D. All the above**
3. **D. Questionnaire**
4. **B. Greater depth**
5. **D. Diary Method**
6. **C. Observations**
7. **D. Computer feedback**
8. **B. Analysis of Computer Records**
9. **C. Internet Browsing Pattern**
10. **A. References and bibliographies**
11. **C. Information**
12. C. **Unconventional Method**
13. **B. Interview**
14. **Analysis of Computer Records**
15. **D. User**
16. **B. Informed and Uninformed Consent**
17. **B. Empathic Modelling**
18. **D. Longitudinal study**
19. **D. Workshop**
20. **B. Focus Group**

UNIT 8

USER EDUCATION: CONCEPT AND NEED

1. **A. Library Instruction**
2. **3**
3. **C. Information Literacy**
4. **True**
5. **19th century**
6. **False**
7. **True**
8. **True**
9. **D. All are correct**
10. **D. All are correct**
11. **engineers and architects**
12. **8**
13. **Norman**
14. **T.D. Wilson**
15. **True**
16. **False**
17. **C. Ethelene Whitmire**
18. **information search process**
19. **A. Choo's Model**
20. **Five**

UNIT 9

RECENT TRENDS IN USER EDUCATION

1. **A. User Education**
2. **D. Library User Guidance**
3. **C. User Orientation**
4. **A. Information Literacy**
5. **B. Multimedia-based User Education**
6. **A. Web-based information literacy education**
7. **A. Competency**
8. **A. multimedia-based user education**
9. **D. Information literacy**
10. **D. All of the above**

5. **D. Full Text**
6. **True**
7. **False**
8. **True**

9. **A. exclusive**
10. **Biomedical literature**
11. **British**
12. **1993**
13. **4**
14. **C. Reijo Savolainen**
15. **D. Dervin**
16. **A. Wilson-Eliss Mix Model**
17. **C. Presentation/Assessment**
18. **D. utilization**
19. **A. Wilson**
20. **Secondary School**

UNIT 10

INFORMATION SEEKING BEHAVIOR: CONCEPT AND METHODS

1. **A. Kuhlthau**
2. **B. Case**
3. **A. Wilson**
4. **C. Delphi technique**
5. **D. Wisdom**
6. **A. George A. Kelly**
7. **A. 1959**
8. **False**
9. **B. Samuel Green**
10. **Seven**
11. **1948**
12. **Active information seeking and use**
13. **Health sciences**
14. **False**
15. **True**
16. **True**
17. **D. characters that are used to assist in searching for information**.
18. **A. The Medical education Subject Headings**
19. **D. Full Text**
20. **A. Specialized search engines**

UNIT 11

AN OVERVIEW OF RESEARCH OUTPUT ON USER STUDIES

1. **B. Consortium of publishers**
2. **D. online or offline both**
3. **A. outcome**
4. **D. users experiences and to improve their quality of service**
5. **C. The US, Australia, Canada, the United Kingdom and other European countries**
6. **B. online**
7. **D. independent and nonprofit**
8. **2**
9. **D. Ohio college and university libraries**
10. **B. Consortium of publishers**
11. **D. online or offline both**
12. **A. outcome**
13. **D. users' experiences and to improve their quality of service**.
14. **C. The US, Australia, Canada, the United Kingdom and other European countries**
15. **B. online**
16. **D. independent and nonprofit**.
17. **2**
18. **D. Ohio college and university libraries**.
19. **A. Online directory of open access journals**
20. **Browsing**

UNIT 12

RANGANATHAN'S PHILOSOPHY ON USER STUDIES: WITH SPECIAL REFERENCE TO FIVE LAWS OF LIBRARY SCIENCE

1. **D. Dr. S. R. Ranganathan**
2. **D. The Fifth law of library science**
3. **C. The Fourth law of library science**
4. **True**
5. **True**
6. **False**
7. **Fales**
8. **D. All the above**
9. **1995**

UNIT 13

RECENT TRENDS IN USER STUDIES

1. **B. Ralph R. Shaw**
2. **D. Information System**
3. **B. Scientists**
4. **Technology advances**
5. **Electronic resources/ new**
6. **True**
7. **False**
8. **True**

UNIT 14

INFORMATION LITERACY: DEFINITION, OBJECTIVES AND IMPORTANCE

1. **B. Paul G. Zurkowski**
2. **Six Stages**
3. **D. McKenzie**
4. **A. Seven Faces of Information Literacy**
5. **A. Seven Faces of Information Literacy**
6. **A. Purpose, Location, Use and Self-evaluation**
7. **A. Big6 Skills**
8. **B. Paul G. Zurkowski 1999**
9. **B. Paul G. Zurkowski**
10. **Six Stages**
11. **D. McKenzie**
12. **A. Seven Faces of Information Literacy**
13. **A. Seven Faces of Information Literacy**
14. **A. Purpose, Location, Use and Self-evaluation**
15. **A. Big6 Skills**
16. **True**
17. **True**
18. **1999**
19. **B. Basic Learning, Library Literacy, Media Literacy, Technology Literacy, Visual Literacy**
20. **D. Chartered Institute of Library and Information Professionals**

UNIT 15

INFORMATION LITERACY 2.0

1. **A. Read / Write Web** 2. **D. all of the above**

3. **C. Social Bookmarking sites**

4. **D. You Tube**

5. **B. Instant Messaging**

6. **A. Information Literacy**

7. **C. Co-producer**

8. **True**

9. **True**

10. **False**

11. **True**

12. **True**

13. **C. Carol Kuhlthau**

14. **B. Krieklas**

15. **C. Chaining**

16. **A. Nicholas Negroponte**

17, **Six**

18. **D. Subject Gateway**

19. **D. all of the above**

20. **A. Digital Library Software**

INFORMETRICS

UNIT 1
LIBRAMETRY, BIBLIOMETRICS, SCIENTOMETRICS, INFORMETRICS, ALTMETRICS, AND WEBOMETRICS

1.0. OBJECTIVES

- The objectives of this unit:
- To understand the Informetrics Phenomena and its specialized terminology;
- To explain the Bibliometrics/Scientometrics scope and application in relation to
- LIS students' learning.
- To explain the model of Bibliometrics/Informetrics to LIS students.
- To show the systematic development of the quantitative analysis study in LIS and
- its application in measuring scientific productivity for any given audience.
- To develop an assessment tool for LIS students on Bibliometrics/Scientometrics
- assignment.

1.1. OUTCOME OF LEARNING

After completing this unit, you will understand the scope and definition of different terminologies used in Informetrics.

1.2. STRUCTURE OF UNIT

- Introduction
- Concept, meaning, and definition of Librametry
- Concept, meaning, and definition of Bibliometrics
- Concept, meaning, and definition Scientometrics
- Concept, meaning, and definition of Informetrics
- Concept, meaning, and definition of Webometrics
- Concept, the theoretical and philosophical foundation of Bibliometrics
- Concept, meaning, and definition of Altmetric
- Summary
- References

1.3. INTRODUCTION

Prof. P. C. Mahalanobis, founder of the Indian Statistical Institute, in the early 1950s argued that Statistics is a "Key technology" – as it is required for all socio-economic development activities and since statistical techniques are used in all development and forecasting studies. In the recent past, statistics have been applied to a number of areas such as perspective planning, industrial and agricultural development, etc. Library and Information managers have adopted several quantitative methods in recent years to evaluate library resources and services more objectively and effectively. Scientometrics/Informetrics refer to quantitative techniques applicable to measure the records of human communication. Over the years, several new terms have appeared on the horizon representing quantitative studies in library and Information Science.

The History of Comparative Anatomy Part-I: A Statistical Analysis by Cole and Eale is considered to be the first bibliometric study in 1917. Hulme was the first to use the expression 'statistical bibliography' in 1923; later several studies have been conducted. Gross and Gross's study is considered to be the third study in the field based on citations. After Hulme, the term statistical bibliography was used by Henkle[4] in 1938 in his article "The periodical literature of Biochemistry" and Gosnell in his dissertation in 1943, and later in his article in 1944. The historical development of the term statistical bibliography has been traced by Witting in a footnote. The term was considered very clumsy, not very descriptive, and can be confused with statistics itself or bibliographies on statistics.

1.4. CONCEPT, MEANING, AND DEFINITION OF LIBRAMETRY

In 1948 at the Aslib's conference in Lamington Spa, Ranganathan introduced the term Librametry for the first time. He suggested developing Librametry along the lines of biometry, econometry, and psychometry. His suggestions were avidly welcomed at the conference by Bernal and others. The term Librametrics has two roots: Libra and Metry. The word 'Libra' connotes 'library' and 'metrics' means measurement. Further, as the librarian of the Madras University Library, he practised various librametric techniques way back in 1925, in order to solve day-to-day library problems and streamline the day-to-day library activities, and services for their clientele and also for the betterment of library professionals as a whole.

The scope of the library is limited to the quantitative study of books, readers, and staff. Here the books, readers, and staff are the library's three constituent elements or factors. The absence of any one of the three will make the library cease to exist. Each has its own potentiality and it is only a sum of the three that makes a library. Thus, we can measure all the Characteristics of books, readers, and staff.

The library book selection, acquisition, accessioning, classification, cataloging, stack arrangement, publicity, reference service, and circulation activities can be measured. The library reader's book use behavior can be quantifiable. The library staff-their satisfaction and dissatisfaction-also can be measured. Even we can include library accounting, budgeting, and manpower planning.

Ranganathan in his paper presented in the DRTC 7th Annual Seminar (1969) suggested a few examples of statistics to library science. Based on his experience and the experiments carried out at the Documentation Research and Training Centre, Neelameghan outlined the applications for Librametrics:

Determination of the strength of library staff;

- Disposition of library staff for circulation work during different library hours;
- Disposition of library staff for reference service during different library hours
- Organization of library system; Establishing the distinction between "service
- library" and "dormitory library";
- Design of library building, fittings, and furniture;
- Book selection;
- Absolute syntax and facet syntax in relation to classification;
- Length of class number;
- Variation in style in writing catalog entries; and
- DOC-Finder.

1.4.1. Statistical techniques are also useful in

- Transfer of a big library from one building to another;
- Periodical changes in the sequence of subjects in the shelving of books in the stack
- room in relation to saving the time of readers.
- Estimation of the opinion of readers about library services received by them;
- Estimation of library use; and
- Accuracy in cataloging work.

The librametric studies if developed properly as suggested by Ranganathan could become a good indicator for measuring various activities of librarianship both quantitatively and qualitatively. It is therefore imperative for the professional schools of library and information science to incorporate Librametrics as a foundation course. Such a step would help us to have an objective as a systematic approach to the field of library and information science.

1.5. CONCEPT, MEANING, AND DEFINITION OF BIBLIOMETRICS

The term Bibliometrics was first coined by Prichard in 1969 in preference to the existing terminology ‘statistical bibliography’. The word “Bibliometrics” has two roots: ‘biblio’ and ‘metrics**.** The term ‘biblio’ is derived from the combination of Latin and Greek word ‘biblion’ equivalent to Bylos, meaning book, a paper which in turn was derived from the word Bylos, a city of Phenonicia, a noted city for export trade in the paper. The word ‘metrics’, on the other hand, indicates the science of meter, i.e., measurement, and is derived either from the Latin or Greek word ‘metricus’ or ‘metricos’ respectively, each managing measurement. This term was coined for the first time by Alan Pritchard. He used the term to describe all 'studies which seek to quantify the process of written communication'. Fairthorne also defined it as 'the quantitative treatment of the properties of recorded discourse and behavior pertaining to it.'

Bibliometrics studies include studies of the growth of the literature in some subjects, how much literature is contributed by various individuals, groups, organizations, or countries; how much exists in various languages; how the literature on some subjects is scattered (e.g., over documentary types, language journals); and how quickly the literature on some subject becomes out-of-date (Studies of obsolescence). Another important group of bibliometric studies relates to what sources the author cites. Day by day this study is attaining sophistication and complexity, having national, international, and interdisciplinary character. The backbone of Bibliometrics lies in its sound theoretical foundation most effectively laid by some pioneers like Lotka, Bradford, Zipf, Duck J de Sola Price, Bookstein, Mandelbrot, Brookes, Garfield, Egghe, and many others, and their techniques are capable of throwing light on various complicated problems faced by information scientists to quantify the process of written communication. The bibliometric tools can be applied to

- Studies related to the scattering of articles
- Geographical distribution, language-wise distribution, institution-wise distribution
- of articles
- Age distribution of documents
- Distribution of citations - subject, author, language, type, journal, etc.
- Use of information storage and retrieval
- Application, in the Library Use Studies.
- To study the trends in research, and identify the growth of literature.
- To identify authorship trends in documents on various subjects.
- to measure the utility of library services
- To evaluate the library collection, etc.

These definitions of librametry and bibliometrics show that Librametry primarily aims at the quantitative analysis of the management of libraries and bibliometrics is limited to recorded knowledge. The publication in both fields suggests that in Librametry and bibliometrics, one examines the statistical distributions of the processes relating to the utilization of documents, Library staff, and Library users, to establish a theory for the structural aspects of the library. Bibliometrics and Librametry may therefore be commonly defined as areas in which one studies 'information processes and information handling in libraries and information centres by quantitatively analyzing the characteristics and behavior of documents, library staff, and library users.'

1.6. CONCEPT, MEANING, AND DEFINITION OF SCIENTOMETRICS

In the 1960s, particularly in Eastern Europe, the term "scientometrics" was used to denote "measurement of informatics process." The term informatics was then widely used to mean "documentation/information handling activities;" obviously, there is not much difference between the bibliometrics of the West and the scientometrics of East Europe. The term Scientometrics originated as a Russian term for the application of quantitative methods to the history of science, which studies the quantitative aspects of science. It was suggested by Dolrov and Kormoni, often used with the same meaning as bibliometrics to mean the application of quantitative methods to the history of science. This term came into prominence with the founding of the journal named 'Scientometrics' by T. Braun in 1977, originally published in Hungary and currently from Amsterdam, The Netherlands. Scientometrics used to mean the communication process in science including socio-cultural aspects and appears to be almost synonymous with science of science with more stress on its quantitative aspects. It is also used as a generic term for a system of knowledge, which endeavours to study the scientific (and technological) system by using a variety of approaches within the area of science and technology studies.

Scientometrics is concerned with the quantitative features and characteristics of science and scientific research. Emphasis is placed on investigations in which the development and mechanism of science are studied by statistical mathematical methods. Scientometrics is now considered a part of the sociology of science and is applied to science policymaking. Thus, Scientometrics involves studies in:

- Sociology of Science,
- History of science,
- Growth of literature
- Behaviour of scientists,
- Science indicators, etc.

Derek John de Solla Price (22 January 1922 – 3 September 1983) was credited as the father of scientometrics. He was a physicist, a historian of science, and an information scientist, and worked as a teacher of applied mathematics at Raffles College (which was to become part of the University of Singapore in 1948). It was there that he formulated his theory on the exponential growth of science, an idea that occurred to him when he noticed the growth in the Philosophical Transactions of the Royal Society between 1665 and 1850. – He had the complete set in his home while Raffles College had its library built. Further, Garfield's contribution to scientometrics is quite significant; his contributions evolved through his Science Citation Index. Merton also had his view on scientometrics; it is based on Mathew Effect.

1.7. CONCEPT, MEANING, AND DEFINITION OF INFORMETRICS

Information, in its most restricted technical sense, is a sequence of symbols that can be interpreted as a message. Information can be recorded as signs, or transmitted as signals. Information is any kind of event that affects the state of a dynamic system. Conceptually, information is the message being conveyed. The English word was apparently derived from the Latin stem (information-) of the nominative (information): this noun is in its turn derived from the verb "informare" (to inform) in the sense of "to give form to the mind", "to discipline", "instruct", "teach": Metrics means measuring. Informetrics is the study of quantitative aspects of information. This includes the production, dissemination, and use of all forms of information, regardless of its form or origin.

According to Brookes the word 'Informetrics' was first proposed by Otto Nacke of West Germany in 1979**.** FID constituted a committee with this name and Nacke was its first Chairman. Rajan, the next Chairman of the Committee, reformulated the objectives of informetrics to provide reliable data for research and development, policy-making, and planning; to evaluate institutions, projects, articles, products, and other academic activities, and to identify or develop the techniques to trace the origins and development of concepts. In a short communication on "Informetrics vis-àvis Bibliometrics: Scope and its Development", Ravichandra Rao mentioned that it is a field wherein the flow of information and behavior of information are analyzed, measured and quantitative relationships are established. It is a scientific field wherein the developments of measurement of the impact of information are assessed continuously. Bibliometrics may therefore be treated as synonymous with informetrics having a scope to analyze quantitative characteristics of information. An FID Committee constituted with broadly defined objectives in the provision of research and technical data subsequently gave this name.

The third International Conference on Informetrics was held in Bangalore in 1991. 'Informetrics' was used as a generic term to mean "The use and development of a variety of measures to study and analyze several properties of information in general and documents, in particular, the study of the quantitative aspects of information in any form, not just records or bibliographies. Informetrics is the study of quantitative aspects of information. This includes the production, dissemination, and use of all forms of information, regardless of its form or origin. As such, informetrics encompasses the fields which study quantitative aspects of science. It is mostly concerned with the development of models to explain and identify the various characteristics of the literature. It also discusses scientific productivity, collaborative research, etc.

1.8. CONCEPT, MEANING, AND DEFINITION OF WEBOMETRICS

The science of webometrics (also cybermetrics) tries to measure the World Wide Web to get knowledge about the number and types of hyperlinks, the structure of the World Wide Web, and usage patterns. According to Björneborn and Ingwersen (2004), the definition of webometrics is "the study of the quantitative aspects of the construction and use of information resources, structures and technologies on the Web drawing on bibliometric and Informetrics approaches." The term webometrics was first coined by Almind and Ingwersen. The second definition of webometrics has also been introduced, "the study of web-based content with primarily quantitative methods for social science research goals using techniques that are not specific to one field of study", which emphasizes the development of applied methods for use in the wider social sciences. The purpose of this alternative definition was to help publicize appropriate methods outside of the information science discipline rather than replacing the original definition within information science.

Cybermetrics is one of the recently emerged fields in the line of metric studies. It has gained much popularity since the mid-1990 with the advent of Information Technology. As it is mainly concerned with the computer-science-based approaches, it has superseded all other metric studies in this Internet Era. Cybermetrics is proposed as a generic term for “The study of the quantitative aspects of the construction and use of information resources, structures and technologies on the whole Internet drawing on bibliometric and Informetrics approaches.” Cybermetrics thus encompasses statistical studies of discussion groups, mailing lists, and other computer-mediated communication on the internet, including WWW. Besides covering all computer-mediated communication by using internet applications, this definition of cybermetrics also covers quantitative measures of the internet’s backbone technology, topology, and traffic. The breadth of coverage of cybermetrics implies large overlaps with proliferating computer-science-based approaches in analyses of web contents, link structures, web usage, and web technologies. Webometrics which studies the quantitative aspects of the World Wide Web. Cybermetrics which is similar to webometrics; but broadens its scope; includes namely electronic resources. Research of all network-based communications by using Informetrics or other quantitative measures is called webometrics.

There has been a revolutionizing symbiosis between computer and communication technologies in the west over the past ten years. The invention of the World Wide Web (www) a part of the ‘INTERNET’, which is the mother of networks, has practically webbed the information globally under less than one roof. There has been a shift in navigational approaches from syntactical to semantic (i.e., from sentences to words), as an ever-increasing number of research institutes, universities and business organizations are currently providing information about themselves in the form of their articles, publications, reports, catalogues and other information resources on the INTERNET in general and the www in particular. This is now becoming the accepted method of disseminating and sharing information resources in hypermedia. Information science research has also changed, with much research to find out, how the new technologies are being used, particularly e-mail and the web. In addition to user studies, there have been attempts to extract new kinds of information from the web. Being a global document network initially developed for scholarly use, it is now inhabited by a diversity of users, and the web constitutes an obvious research area for bibliometrics, scientometrics, and informetrics.

1.9. BIBLIOMETRICS, THEORETICAL AND PHILOSOPHICAL FOUNDATION

Bibliometrics is concerned with theoretical and philosophical foundations. Some of the important studies on theoretical and philosophical foundations are in the area of

- Law of Scattering (Bradford’s law)
- Author productivity (Lotka’s law)
- Word productivity (law of Least Efforts)
- Success-breeds success phenomenon
- Circulation theory
- Information Product and Processes (IPP) and Duality in IPPs

There are other theoretical studies, especially in the area of circulation theory, citation analysis, sources-items relation, etc. Some of these are discussed in:

- Quantitative Method for Library and Information Science. By I K Ravichandra Rao. Wiley-Eastern. New Delhi. 1983.
- Proceedings of the ISSI Conferences in Scientometrics and Informetrics (held biannually since 1987)
- Introduction to Informetrics: Quantitative Methods in Library, Documentation and Information Science. By Leo Egghe and Ronald Rousseau. Elsevier. Amsterdam. 1990
- Power Laws in the Information Production Process: Lotkaian Informetrics. By Leo Egghe. Elsevier. Amsterdam. 2005.

Studies based on citation data have several limitations. They are:

- Citation studies are mostly dependent on data from databases such as the Web of Science, SCOPUS, etc. which cover only a limited number of journals, and its coverage does not remain constant since new journals are added regularly and some are dropped,
- Solutions to problems of eliminating self-citation are cumbersome.

A primary objective of bibliometric research is the development of a general and systematic set of theories from which hypotheses can be generated and tested. Scientometric studies vary from each other from several points of view. They adopt different methods of data collection as well as different techniques. Even there are no universally accepted terminologies. In addition, the use of algebraic symbols varies from one study to another. Under these circumstances, it would be difficult to think of "bibliometric or scientometric standards," let alone formulate them.

Most of the Scientometrics studies are empirical in nature. In such circumstances, to reproduce the research, one has to repeat the survey and analyze the data right from the beginning. Even then, we may not get the same result! In natural sciences, it is possible and quite common that research may be repeated in laboratories. But in social sciences, this is not only difficult but is not possible. Further, an important cause of the overall unreliability and therefore a cause of invalidity in any basic research in the social sciences are space and time factors. It is therefore difficult to reproduce the results of research.

The fact, whether we call our research area librametry or Bibliometrics or Scientometrics or Informetrics most of the topics we deal with are:

- Quantitative aspects of library and information studies, especially use and user studies, growth of the collection, the page distribution of documents, circulation statistics, etc.
- Journal productivity (by coverage, by use, citation, cost-effectiveness measures, impact factor, h-index, sources of citations, the immediacy of citations, age of sources cited, coverage in databases, etc.)
- Measures of productivity or author productivity, including studies related to multiple authorship (number of publications. cost-effectiveness measures, impact factor, h-index, reprint request, photocopies made, sources of citations, the immediacy of citations, number of reviews, adoption rates (textbooks), etc.)
- Obsolescence and growth of literature
- Co-citation, bibliographic coupling, co-word analysis, rank distribution of words, etc.
- Quantitative analyses of science (science indicators -- country-wise, language-wise, subject-wise, etc.)
- Identifying relationships among various disciplines, the structure of subjects, etc.

- Evaluation of scientific research (by institutions, by individuals, by countries, etc).

Acceptance of a single term to define a subject and acceptance of its scope are necessary for any scientist. Otherwise, it is difficult to include it in a syllabus. It is also difficult to get a research grant from different agencies. It helps us in identifying the research groups, especially at national and international levels. At present, the term 'scientometrics' is used as a synonym for both 'bibliometrics' and 'informetrics'.

In order to encourage communication and exchange of professional information in the field of scientometrics and informetrics, a Society, called 'the International Society for Informetrics and Scientometrics' (ISSI) was founded in 1993. It is an association of professionals active in the emerging interdisciplinary fields of informetrics, bibliometrics/scientometrics, Technometrics, and webometrics. Among its members are scientists from over 30 countries representing all five continents. The Articles of Association state that the aim of ISSI is the advancement of the theory, methods, and explanations through the following two main streams:

Quantitative Studies related to

- Scientific, technological, and other scholarly substantive information.
- Science of science and technology, social sciences, arts, and humanities.
- Generation, diffusion, and use of information.
- Information systems, including libraries, archives, and databases

Mathematical, Statistical, and Computational Modelling and Analysis of Information Processes.

The Society was founded at the International Conference on Bibliometrics, Informetrics and Scientometrics held in Berlin, on 11-15 September 1993. This conference was the fourth of a series of prominent biennial conference that subsequently has been held under the auspices of the Society. The first three earlier conferences were held in Diepenbeek, Belgium (1987, Chairman: Dr. Leo Egghe), London, Ontario, Canada (1989, Chairman: Dr. J M Tague), and Bangalore, India (1991, Chairman: Dr. I K Raviachandra Rao). The Society was incorporated with formal Articles of Association in 1994 in the Netherlands (Utrecht.) Dr. Hildrun Kretschmer was elected its first President With Berlin as its virtual centre COLLNET was set up on January 1st, 2000, under the leadership of Hildrun Kretschmer, in her capacity as coordinator. The network is to comprise prominent scientists, who work at present mostly in the field of quantitative science studies, coming from 15 countries in America, Asia, Australia, and Europe. The intention is to work together in co-operation both on theoretical and applied aspects. COLLNET conducts a year International conference in scientometrics.

There are three important journals in scientometrics -- Journal of Scientometrics, the Journal of Informetrics, and COLLNET Journal of scientometrics and Information Management. The journal publishes original studies, short communications, preliminary reports, review papers, letters to the editor, and book reviews on scientometrics. Due to its fully interdisciplinary character, the journal is indispensable to research workers and research administrators. It provides valuable assistance to librarians and document lists in central scientific agencies, ministries, research institutes, and laboratories.

On 27th March 2011at Tumkur in India**,** the Institute of Scientometrics was founded by Prof S L Sangam, with an objective to promote research in Scientometrics. It is a virtual and non-profit organization. which has been set up by. Much of the research work in this area was carried out in the National Institute of Science Communication and Information Resources (NISCAIR, a wing of CSIR) (formerly known as INSDOC), National Institute of Science Technology and Development Studies (NISTADS, a wing of CSIR) and Documentation Research and Training Centre of the Indian Statistical Institute. In recent times, a number of research works were published by the Department of Library and Information Science of many Universities in India. In 2009, UGC recognized the Department of Library and Information Studies of Karnataka University as a Special Assistant Program (SAP) in scientometrics.

1.10. CONCEPT, MEANING, AND DEFINITION OF ALTMETRIC

Jason Priem coined the word 'altmetrics,' which refers to the online scholarly practice, particularly the social web, as an alternative or complement to standard citation metrics for academic research. Altmetrics are quantitative and qualitative statistics that are used in conjunction with traditional citation-based metrics. Altmetrics, which are derived from the Web, can reveal a lot about how frequently journal articles and other scholarly outputs such as datasets are discussed and used around the world. As a result, altmetrics have been integrated into the webpages of researchers, institutional repositories, journal websites, and other places.

Altmetric measures the impact of each article through the attention attracted online. Moreover, the altmetric score reveals the instantaneous attention attracted online to articles in news outlets, comments on blogs, number of tweets, and mentions on social media. There are two types of altmetric scores. The altmetric-mentioned score includes data sources involving social media (e.g., Facebook, Twitter), newspapers, encyclopedias (e.g., Wikipedia), online platforms (e.g., Faculty1000 and publication peer reviews), videos on YouTube, question-and-answer sites (e.g., Q&A stack overflow), and policy documents in PDF form available over the internet. The altmetric reader score includes data sources involving reference managers available online (e.g., Mendeley, CiteULike, and Connotea). The Altmetric score can be graphically represented by a “donut.” The different colors of the Altmetric doughnut represent the number of mentions on each specific online media source. For example, mentions on Twitter are represented in blue.

In general, altmetrics is introduced as an umbrella term, and it incorporates data regarding usage statistics such as views, likes, shares, downloads, comments, and online social media attention of scholarly literature. Many researchers have argued the term and named it “influmetrics” or “web-based social influence” and “uses metrics” instead. Beyond citations, altmetrics provide new possibilities for accessing not only academic impact but also the broader impact of scholarly artefacts, including public engagement with research. However, it measures digital scholarship on the Internet and how people interact with others in a given scientific work, particularly measured web-driven scholarly interactions, such as how often scholarly work is viewed, blogged, tweeted, re-tweeted about, or bookmarked.

1.11. SUMMARY

From the point of view of the library and information centres, it is essential to evaluate and study the research trends from time to time, so that it would be quite easy for designing, organizing, and managing the various information services and products to cater to the information needs of researchers effectively, expeditiously, and exhaustively. The field of cybermetrics exceeds the boundaries of bibliometrics, because some activities in cyberspace normally are not recorded but communicated synchronously as in chat rooms. Cybermetric studies of such activities still fit in the generic field of Informetrics is the study of the

quantitative aspects of information "in any form" and 'in any social group" as stated by Tague-Sutcliffe (1992). The inclusion of webometrics
expands the field of bibliometrics, as webometrics inevitably will contribute to further methodological developments of web-specific approaches. As ideas rooted in bibliometrics, scientometrics, and Informetrics contributed to the emergence of webometrics, ideas in webometrics might also contribute to the development of these all-embracing fields.

1.12. MCQ QUESTIONS

1. Who was first to use the expression statistical bibliography? A. Cole, F.J B. Eale, N.B C. Hulme, E. W D. Gosnell, C
2. The term Librametry was used by Ranganathan in: A. 1948 at the Aslib's conference Lamington spa B. IFLA conference in 1948 C. DRTC conference in 1948 D. IASLIC conference in 1948 181
3. Biblio means A. Book or paper B. Name of the Place C. Name of the Journal D. Name of the Library
4. The Scientometrics originated from ______ term A. Greek term B. Latin C. Russian D. German
5. The word Informetrics was first used by A. Brookes B. Bradford C. Tedd D. Otto Nacke
6. Librametrics appeared in the year ________
7. Bibliometrics in the year __________
8. Scientometric studies involve A. Opinion Survey B. Expert Evaluation C. Capturing Know-how D. Analysis from textual data
9. Technology Forecasting does not include A. Content Analysis B. Expert Opinion C. Trend Analysis D. Modelling and Simulation
10. Logistic or S shaped growth is A. Exponential growth B. Combination of exponential growth and asymptotic growth C. Linear growth D. Combination of exponential and linear growth
11. Altmetrics is used to measure: A. Measuring the height of a peak B. Measuring the height of a person C. Measuring the impact of scholarship in new media D. Measuring the scholarship of an author
12. National Informatics Centre (NIC) was established in the year- A. 1976 B. 1977 C. 1978 D. 1975
13. The 'Open J-Gate' of Informatics India is ______________ service.
14. Webometrics ___________

15. Name the authors who have coined the term Webometrics A. Tomas Almind and Peter Ingwersen B. Lennart Bjorneborn & Peter Ingwersen C. Peter Ingwersen & Mike Thelwall D. Mike Thelwall and Judit Bar-Ilan

16. Webometrics is the study of ______ A. Measuring the quantitative aspects of books B. Measuring the quantitative aspects of journals C. Measuring the quantitative aspects of information D. Measuring the quantitative aspects of the web phenomenon

17. Which of the following journals was started in 1997 to boost webometrics research A. Informetrics B. Scientometrics C. Cybermetrics D. Webometrics

18. Bibliometric mapping is basically based on A. papers published in scientific journals B. technical reports C. book chapters

19. Unconventional method of user studies comprise of what? A. Citation studies B. Bibliometric studies C. Studying biographies/autobiographies or diaries of library users D. All of above

20. Informetrics appeared in the year 1980

1.13. SHORT QUESTIONS

What is the meaning of webometrics?

What is the difference between bibliometrics and scientometrics?

What does Altmetric mean?

What does mean by librametric?

Why is informetrics important?

1.14. LONG QUESTIONS

How do you do the scientometric analysis?

Write an essay on Iibrametrics.

Discuss in detail the scope and use of bibliometrics in library management.

What do you mean by bibliometric techniques? Explain some of such techniques with examples.

What is the difference between qualitative and quantitative techniques? Explain with suitable examples.

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UNIT 2

<u>LAW OF SCATTERING AND ITS APPLICATIONS</u>

2.0. OBJECTIVES

- To know the Bibliometrics impact in the evaluation of scientific research.
- To study and understand the Derivation of equations for Bradford distribution by various bibliometrics.
- To discuss Bradford-Zipf's distribution.
- To know Lotka's laws of Bibliometrics.

2.1. OUTCOME OF LEARNING

After completion of this module, you will be familiar with three classical laws of Bibliometrics and their applications. Particularly, you have learned Bradford's law, Lotka's Law, and Zipf's law.

2.2. STRUCTURE OF UNIT

- Introduction
- Bradford's Law of Scattering
- Zips's Laws
- Lotka's Law
- Summary
- References

2.3. INTRODUCTION

Classical laws in Bibliometrics include Bradford's law of scattering, the three laws of Zipf, and Lotka's law. These are purely scientific laws that are well-established formulas and the concepts embedded in them are less likely to change with time. Moreover, their validity can be verified scientifically.

2.4. BRADFORD'S LAW OF SCATTERING

Samuel Clement Bradford was a chief librarian in the National Science Library in England from 1925-1938. While in this position he became concerned with the problems of omission and overlap in the coverage of primary journal literature by indexing and abstracting services. In an article published in 1934, he wrote:

"Those who are concerned with progress in science and invention are aware of the need for the provision of efficient service for abstracting and indexing scientific and technical literature. It is therefore somewhat disquieting to find on inquiry that although the 300 abstracting and indexing journals notice 750,000 articles each year which is the same as the total number of papers published in their fields; owing t duplication of effort, only 250,000 different articles are dealt with and 500,000 are missed. It seemed worthwhile to inquire whether the cause of this failure might not lie in the manner in which the literature of a subject is distributed among the periodicals that contain it, ...the results fully confirm this view."

Bradford started from the premise that the problem was due to the overlapping; nature of scientific specialities, stating every scientific subject is related, more or less remotely, to every other scientific subject and that therefore, the articles of interest to a specialist must occur not only in the periodicals specializing on his subject but also, from time to time, in other periodicals."

He applied this principle in an analysis of two specific subjects by examining bibliographies, or lists of papers, compiled for Geophysics and Lubrication. He then prepared lists of journals; where the journals were arranged by decreasing order ~f the number of articles contributed by them to the bibliographies. He noticed that in each subject there were very few productive journals that contributed many articles to the bibliography. A large number of journals contributed a few articles each and an even larger number contributed one or two articles to the bibliography This empirical observation formed the basis of a mathematical relationship regard € the number of journals of different levels of productivity. The relationship is n known as Bradford's law. The results were published in a paper in 1934 and in a book called Documentation in 1948.

Bradford's work became influential because of its applicability in the efficient retrieval of information. His book brought together his research that laid the groundwork 'o the many applications for citation analysis and bibliometrics. It now appears to concern issues on the management of libraries that existed since ancient tit e: The origins of bibliometric studies have been traced back to the ancient Egyptian Alexandrian Library in a study by Nisonger. In India, Ranganathan was a pioneer in the use of statistical methods in the management of libraries. Although such studies have occurred down through the centuries, Bradford's Law formulate in 1934 again brought bibliometric studies into prominence.

2.4.1. Verbal Form of Bradford's Law

Bradford found that in any given subject the number of journals in each zone in decreasing order of productivity increases in a geometric progression, starting with the most productive journals j0, as j0, j0 r, j0 r2, where j0 is the number of core journals. The core journals are usually the most important journals for the subject. The parameter `r' is a constant for a given bibliography, also known as the Bradford multiplier.

This is known as the verbal form of Bradford's Law since Bradford also gave another version of his relationship which will be described in the next section.

Bradford formulated his law after studying a bibliography of geophysics, covering 1332 articles from 326 journals in the field. He discovered that 9 journals contained 429 articles, 59 contained 499 articles, and 258 contained 404 articles. So, it took 9 journals to contribute one-third of the articles, 9, or 45, to
produce the next third, and 5 times 9, or 225, to produce the last third. As may be seen, Bradford's Law is not statistically accurate, strictly speaking. But it is still commonly used as a general rule of thumb. It was later found by Vickery that the number of zones need not be restricted to three. In fact, if a bibliography contains A articles contributed by a number of journals J, it can be sub-divided into a number of zones n, each contributing the same number of articles A/n, and containing j_o, J_1, j_2, j_{n-1} 1 journals, then

$$j_1 = j_0 r$$

$$j_2 = j_0 r^2$$

$$\ldots\ldots\ldots,$$

$$j_{n-1} = j_0 r^{n-1}$$

In an example in the next section, we shall demonstrate how the same bibliography can be divided into a different number of zones. Note, however, that the value of the Bradford multiplier will depend on the number of zones and is not fixed for a given bibliography.

Bradford's law is not a law in the sense that it has not been proved and is not exact, but has been verified to be approximately true in many cases as to be sufficiently general and usable for most applications. We shall discuss the deviations from this law in a later section.

2.4.2. Applications of Bradford's Law

Notice that each succeeding Bradford zone contains a successively larger and larger number of journals. This means that if we start our search with the most productive journals, then as we go along, to retrieve the same number of articles, we have to scan more and more journals. In other words, there is a law of diminishing returns for the effort expended in conducting the search.

2.4.3. Application to abstracting services

Abstracting services would like to give as complete coverage as possible to the literature. However, the cost of scanning journals increases in proportion to the number of journals covered. On the other hand, the number of articles actually retrieved depends on the type of journal scanned. It is, therefore, a good procedure to rank the journals as described in the Bradford sense and begin scanning from the most productive journal, followed by other core journals. In this way, one would get the maximum coverage at the lowest cost. Since the retrieved articles decrease as one proceeds from the most productive journals in the core to the less productive peripheral journals, whereas the cost per journal scanned remains constant, at some point, it is no longer cost-effective to continue the search. This should become clearer once you go through the example given later in this section.

If an abstracting service wishes to provide a comprehensive bibliography, i.e. include all the papers published, it would be necessary to scan all journals. The number of journals to be scanned, and therefore the effort and time required to retrieve an equivalent number of papers would increase as it moved from the zone of highly productive journals to the less and less productive ones. This would imply increasing costs. At some point along the way, the cost may exceed the money that the abstracting service expects to retrieve from the persons who would subscribe to the service. Such a service would then not be economically viable and would have to be stopped.

On the other hand, because of the concentration of particles in the most productive journals, by simply scanning say the core journals, the service covers one-third *of* the articles by searching through a much smaller fraction of the total journals.

Example 1

A complete bibliography of Flying Saucers of 3000 articles with 3 zones has a core size of 10 journals and a Bradford multiplier of 2. The cost of scanning a journal is Rs. 10, while the company provides articles to subscribers at Re 0.01 per article. If there are 200 subscribers, calculate what is the rate of profit for covering (i) the first zone, (ii) the first 2 zones, and (iii) all three zones.

Solution: Each of the 3 zones contain 1/3 of the total bibliography, e.g. 1000 articles. The first zone contains 10 journals. The next zone contains 10*2 = 20 journals. The 3rd zone contains 10*2^2 = 40 journals. Based on this we can construct the following table:

Zone	1 (core)	2	3
Articles	1000	1000	1000
Journals	10	20	40
Cost *of* scanning	Rs. 500	Rs. 1000	Rs. 2000
@ Rs. 50 per journal Cost to retrieve one article	Re. 0.50	Re. 1	Rs.2
Earning from 100 subscribers @ Re 0.01 per article	Rs. 1000	Rs, 1000	Rs. 1000
Profit	Rs. 500	Rs.0	Rs. 1000

i. Article coverage is 33% by scanning 10/70 = 14% journals at a profit rate of (500* 100/500) = 100%
ii. Article coverage is 66% by scanning 30/70 = 43% journals at a profit rate of 500* 100/1500=33% iii. Article coverage is 100% by scanning 100% of journals at *a loss* of 500* 100/3500 = 14%

This is an application of Bradford's law which indicates the loss of information when the search is limited by considerations of cost, etc.

2.4.4. Application to library holdings

Possible applications of Bradford's law could be the question of journal subscriptions or planning space for a library. An optimal library size may be determined based on the scattering of articles among the journals on different subjects. If a library covers several subjects, due to their overlap the core journals in a particular subject will often serve as the peripheral journals for other subjects. The overlapping nature of disciplines implies that the core journals in a field will sometimes publish articles in adjoining disciplines. In other words, they act as peripheral journals for other fields. Thus, the core journals for a set of subjects will automatically include some of the peripheral journals in these subjects ensuring better coverage all around. Library size does not increase in proportion to the number of areas covered, and a general science library covering 10 fields is not necessarily 10 times larger than a specialized library covering a single field. This has important implications for resource allocation of space and finance in the planning *of* libraries and indexing services because it states that much of the scientific literature is concentrated in a set of journals that form the core of the scientific literature.

2.4.5. Garfield's Law of Concentration

The extension of Bradford's law from one to several disciplines has been put in the form of a law by Eugene Garfield, a pioneer in the field of information. Garfield was publishing several indexes, including the Science Citation Index (SCI), through the Institute for Scientific Information (ISI) in America and processing citations to journal articles in several disciplines. His studies revealed that a multidisciplinary mix *of* 152 journals accounted for 50% of the citations processed for the SCI in 1969. This finding caused Garfield to formulate his law of concentration, which he derived from Bradford's law of scattering by extending it from the level of a single discipline to that of science as a whole

Garfield devised a physical analogy to Bradford's law, one based upon a cornet, where, the nucleus of the comet represents the core journals of a discipline's literature with the debris and gas molecules of the tail representing the additional journals that sometimes publish material relevant to the discipline. With this analogy in mind, Garfield described his law of concentration and its practical implications in the following manner
" .... The bibliographic law of concentration goes a step beyond the Bradford law by stating that the tail of the literature of anyone discipline consists, in large part, of the cores of the literature of all other disciplines, and that all the disciplines combined produce a multidisciplinary literature core for all of the science that consists of no more than 1,000 journals. In fact, this multidisciplinary core might be as small as 500 journals. Though larger collections certainly can be justified in many cases, the single
function of providing reasonably cost-effective coverage of the literature most used by research scientists requires no more than 500 to 1,000 journals."
According to Garfield, Bradford's principle has been kept in mind in the provision of indexing services by ISI

$$\mathrm{In}\frac{R_2}{R_1} = \mathrm{In}\frac{R_3}{R_2} = \mathrm{In}\frac{R_4}{R_3} \ldots\ldots \mathrm{etc}$$

To illustrate his law, Bradford also plotted the cumulative number of articles against the logarithm of the journal ranks. The cumulative number of articles Corresponding to the journal rank R is the total number of articles obtained from journals up to am including the journal of rank R.

The J-shaped graph that Bradford obtained, also called the Bradford bibliography appeared as an upward curve before it became linear. The curve plotted for the bibliography of Lubrication used by him is shown in Fig.1.

Notice that the Bradford curve has a rising portion, consisting of journals with the highest productivity. The area described by the curving line is usually regarded as the "nuclear zone" or journal core. This is followed by an almost linear portion or mid-section where the cumulative number of articles contributed by journals up to a given rank increases proportionately with the logarithm of the rank. This is also the part that corresponds to the verbal form of Bradford Law as we shall see below.

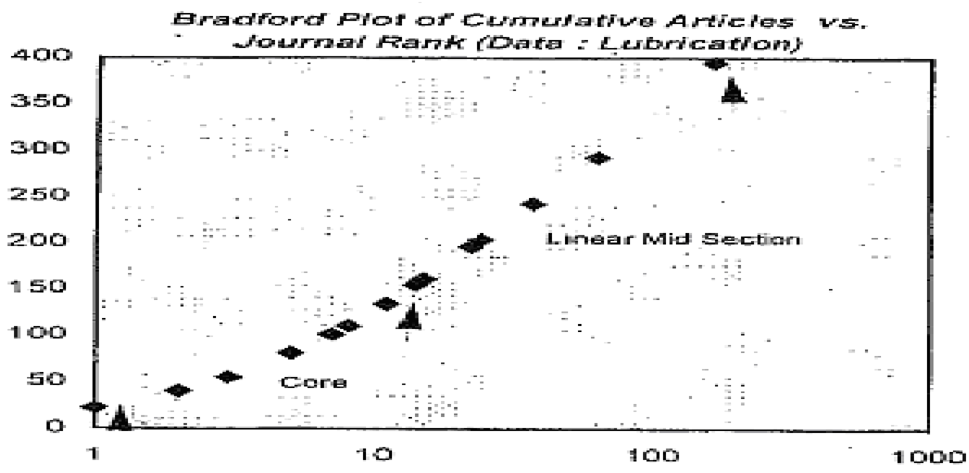

Fig. 1

If we divide the straight-line portion into zones each containing the same number of articles, then each zone corresponds to a set of journals. Let the zone containing journals between ranks R_2 and R_I yield articles A_Z-A_1, the next zone containing journals between ranks R_3 and R_2 yield articles A_3-A_2, etc.
Since the slope of the straight-line portion is constant, it is easy to see that

$$\frac{A_2 - A_1}{\text{In}R_2 - \text{In}R_1} = \frac{A_3 - A_2}{\text{In}R_3 - \text{In}R_2}$$

Also, since the zones contain the same number of articles, Therefore,
In R_2-InR_1 = InR_3-In R_2
or,

$$\text{In}\frac{R_2}{R_1} = \text{In}\frac{R_3}{R_2} = \text{In}\frac{R_4}{R_3}\text{......etc}$$

The solution to this equation is a geometric progression.

$R_1 = a$
$R_2 = ar$
$R_3 = ar_2$

where a = the number of journals in the first zone and the number of journals in each successive zone of lower productivity increases by a factor of r.
Note that this is almost the same as the verbal form of Bradford's Law.
Bradford did not give a mathematical model for his law. Models were suggested later by Brookes, Vickery, and Leimkuhler.

2.4.6. Conditions for Bradford's Law

It was suggested by Brookes that for strict conformity with Bradford's law certain conditions have to be imposed on the bibliography. They are:

- The subject of the bibliography must be well-defined

- The bibliography must be complete; that is, all relevant papers and serials must be listed,
- The bibliography must be of a limited time span so that all contributing serials have the same opportunity of contributing papers.

However, it has also been shown by Bookstein that the shape of the curve is fairly robust and does not change much in spite of the variables such *as* subject, time span, etc. not being very well defined.

2.4.7. Falling Tail of Bradford's Curve; The Groos Droop

In 1967, it was noticed by Groos that the curve plotted from actual data on journals and articles has a linear portion that falls off at the tail end of the less productive journals. This phenomenon is today known as Groos droop because, the curve drops at its end, giving it an S rather than a J shape, as seen in the bibliography of Agriculture plotted by Lawani, shown in Fig. 2. The sloping part at the top of the Bradford curve is called the Groos droop.

Data on Publications in Agriculture

(Lawani' 9373)

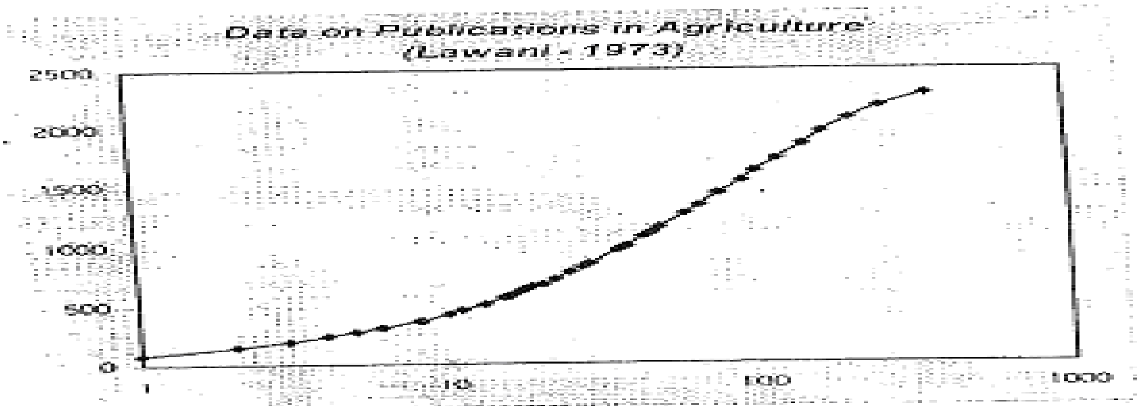

Fig. 2

Brookes discussed the Groos droop and argued that the droop was an indication 3f the incomplete nature of the bibliography examined. His hypothesis was that the strength of the Groos droop reflects the (in) completeness of a bibliography. He also developed a method for estimating the total size of the bibliography.

However, opinion on the reason for the droop was divided. While Brookes felt at this was due to the incompleteness of the bibliography, others like Wilkinson and O'Neill showed that in many cases the S-shaped curve gave a better description of the data plot than the J shaped curve.

In any case, this portion of the curve corresponds to the least productive journals, either non-specialized or specializing in other fields, and therefore is not very important from a practical point of view. However, if one considers the theoretical basis of the law, as to what factors give rise to this pattern of scattering, then the details of shape become important.

2.4.8. Ambiguity in Bradford's Law

Bradford's verbal formulation of the law of scattering was not mathematically equivalent to the graphical representation described in his original article in 1934. The verbal form was the result of theoretical speculation while the graphical form was obtained from empirical data derived from the two bibliographies with which he worked. The verbal portion corresponds to the linear portion of the bibliography, but not to the entire graph with its rising portion. This was noticed by Vickery who also pointed out that the relation holds for any number of zones and not just three zones as in Bradford's original formulation.

The graphical formulation has been found to be more accurate when compared with data and also more convenient to use. The nucleus is easily identified and deviations from the verbal form of Bradford's law such as the Groos droop may easily be detected in actual observed data

2.4.9. Fitting Bibliographic Data to Bradford's Law

Following Egghe and Rousseau, we apply the fitting methods to the bibliography of Lubrication, the data for which can be found in Bradford (1934). In principle, the number of zones n may be chosen freely, although some limitation is necessary since the data are finite. We first consider n = 3 and next n = 7 just to show that n can be chosen more of less freely.

Each zone contains a0 articles, where
AO=A/N [I]
r = *(ey* am)l/N = (1.781 am) I/N [2]
Furthermore, since j0 + jOr + ... + jOrN-l = J, by taking the sum of the geometric progression we get,
JO = J(r-l)
rN - 1

Table 1: Data of 'Lubrication (1934)

No. of journals(j)	Corresponding no. of articles (a)	Articles (col.1 *col.2)	Rank (R) of journal	Cumulative no. of articles
1	22	22	1	22
1	18	18	2	40
1	15	15	3	55
2	13	26	5	81
2	10	20	7	101
1	9	9	8	110
3	8	24	11	134
3	7	21	14	155
1	6	6	15	161
7	5	35	22	196
2	4	8	24	204
13	3	39	37	243
25	2	50	62	293
102	1	102	164	395

[Note on calculation of rank and cumulative number of articles:

The rank corresponding to any row is obtained by adding the number of journals with higher or equal productivity.

The papers are obtained by taking the product of the first two columns. The cumulative papers corresponding to a given rank are the total of all papers obtained from journals of higher productivity.

Applying it to the data on Lubrication, (table 1) we get the following:

1) Bradford data fit for number of zones n = 3
We have

r = (1.781 * 22)1/3$^{=}$3:40
a0 = 395/3 = 131.67 ,132 and
j0 = 164(r-l)/r3-1 =1.0.30. Hence we use [j0] = 10.

The zones for n = 3 are shown in Table 2

Table 2: Lubrication data divided into 3 zones

	No. of journals	No. of articles	r
1 st zone	j0= 10.30 _ 10	126	-
2nd zone	j0r = 35.02 _ 35	133	3.50
3 rd zone	J0r^2= 119, which is exactly the last	136	3.40
	rank in the bibliography		

This is a better fit than Bradford's original example (Bradford (1934)) where he gets 8/29/127 journals yielding respectively 110/133/152 articles.

Exercise

Break the data as Bradford would have done and determine the vah of the core journals and the Bradford multiplier as obtained by Bradford.

1) Bradford data fit for number of zones n = 7
Here we find

R=1
69, ao 56 and
Jo=2
95=132

The Bradford zones: for N = 7 are shown in Table 3

Table 3: Bradford zones for 7 zones (Lubrication)

	No. of journals	No. of articles	r
1" zone	J_o 2.95 =3	55	
2nd zone	$J_o r$ = 4.98 =5	55	1.67
3rd zone	$j_o r^2$ - 8.42 =8	56	1.60
4"' zone	$j_o r_3$ = 14.	56	1.75
5"' zone	$j_o r_4$ = 24.	55	1.71
6E" zone	$j_o r^5$ = 40.	49	1.71
7'" zone	$j_o r^b$ = 68.68 =69 which	69	1.68
	exactly the last existing		

*Note on Statistical Regularity and Underlying Causes and models for the Bradford Phenomenon

2.5. ZIPF'S LAWS

Zipf's laws are related to the usage of words by individuals. Interestingly, the phenomenon follows a scientific law. Most probably, the French stenographer, Jean-Baptiste Estoup (1858-1950), is the first individual to observe the hyperbolic nature of the frequency of word usage. Estoup recorded his study in his book Gammes Stenographiques published in Paris in 1916. George Kingsley Zipf (1902–1950), the American linguist, saw the 4th edition of Estoup's book worked further on it and arrived at his laws in 1935.

"If the number of different words occurring once in a given sample is taken as x, the number of different words occurring twice, three times, four times, n times in the same sample, is respectively $1/2^2$, $1/3^2$, $1/4^2$, ...$1/n^2$ of x, up to, though not including, the few most frequently used words; that is, we find an unmistakable progression according to the inverse square, valid for well over 95% of all the different words used in the sample" [13, Preface, p. vi]. Basing this phenomenon, Zipf developed the formula $ab^2 = k$, where a is the number of words occurring b times and k is a constant. It is observed that the equation satisfies quite well with the less frequently used words of the sample, which is much more in number compared to the more frequently used words in the sample.

2.5.1. Explanation

Suppose in particular writing, the number of words that occurred only once is 1440. In that case, the number of words occurring 2, 3, and 4 times as likely to be $1440 \div 2^2$, $1440 \div 3^2$, and $1440 \div 4^2$, that is 360, 160, and 90. Now, using this data and the formula, we can determine the value of k. We know, that 1440 words have occurred only once, which means a = 1440, b = 1. Therefore, $k = ab^2 = 1440 \times 1^2 = 1440$. Now, using the value of k, we can find out how many words have occurred 5 times, 6 times, or any other number of times. In this case, the formula will be $a = k/b^2$. Let us try to find out how many words have occurred 6 times. We know k = 1440, and b = 6. Putting these values in the aforesaid equation, we get $a = 1440/6^2 = 40$; around 40 words are likely to occur 6 times each. It is to be noted that the values will change with every piece of writing, literary or non-literary.

2.5.2. Verification

The manual verification of the law is highly laborious and time-consuming. The best way to Verify the law is to take the help of information technology as detailed under the second law.

2.5.3. Uses

The use of this law in library and information science (LIS) is still negligible, maybe because it is not generally taught in our LIS courses. It will be useful in identifying the style of writing of an author. The only case I know about its application is that of a student of the University of Calcutta who is trying to find out to what extent the writing of a noted Bengali scientist has been influenced by a foreign lady. The details will be known when the thesis is submitted and the degree awarded.

2.6. Second Law - Definition

Zipf defined the second law as 'The conspicuousness or intensity of any element of language is inversely proportionate to its frequency. Using X for frequency and Y for conspicuousness (rank)
'the law can be mathematically expressed as

$$ya\frac{1}{x}$$

$xy = \pi$ where n is a constant.

2.6.1. Explanation

The words conspicuousness or intensity can be simply termed as rank, and element can be simply taken for word. The definition can be stated in simpler terms as the rank of any word of a language is inversely proportional to the frequency of its usage. The lower the rank, the higher will be the frequency.

2.6.2. Verification

The verification of the Law came through the use of Miles L Hanley's Index of Words for James Joyce's Ulysses. Zipf found that the rank frequency word distribution 'approximate the simple equation of an equilateral hyperbola: r x f = C'` [14, p.24], where r indicates rank and f frequency". C in the equation is the constant. The Product in Table 3 represents constant. The constant in the case of this Law is not a fixed number, but close to it. A part of the result of Zipf's experiment is reproduced below in Table 3.

Rank ®	Frequency (f)	Product ©
10	2653	26530
20	1311	26220
30	926	27780
40	717	28680
50	556	27800
100	285	28500

Manual verification of the Law is highly laborious and time-consuming. In the absence of Hanley's Index of Words for James Joyce's Ulysses Zipf's experiment would have been really difficult. The advent of information technology has given us devices with which we can verify the Law without much difficulty. The steps involved in the verification are given below.

- Take a piece of writing in English containing not less than 5,000 words. The writing can be an article, a short story, a novelette, a part of a novel, or even technical writing.
- Scan the selected writing with an optical character recognition (OCR) software viz. OmniPage Pro.
- Save the file in a suitable software package such as Microsoft Word for Windows.
- Check the file with the original to ascertain accuracy.
- Consider only the textual portion of the writing and remove the names of the authors, author affiliations, abstract, keywords, alpha-numeric expressions like 2nd and F10, alpha-symbolic expressions like au=, and su=, abbreviations such as FDT and ISO, numbers are written with digits (eg 324), serial numbering such as a), b), etc.,

formulas, punctuation marks, intra- and extra-textual references, tables, figures, and appendices.

- The rationale behind the exclusion of the names of authors and author affiliations is obvious because they don't represent the author's style of writing and as such cannot be used for word counting. The keywords are sometimes chosen consulting a thesaurus where the author has little choice and sometimes added by the editor. Hence, it felt safe to exclude them. An abstract is the condensed version of an article and does not necessarily represent the normal style of writing of an author. Moreover, sometimes the abstract is prepared by someone other than the author. Therefore, it was not considered. Alpha-numeric, as well as alpha-symbolic expressions, abbreviations, numbers written with digits, as well as alpha-symbolic expressions, abbreviations, numbers written with digits, serial numbering with a, b, c, etc., and formulas, serial numbering with a, b, c, etc., and formulas, are not words, hence excluded. The references comprise certain fixed elements such as author, year, the title of the article, and other bibliographical details which are not the creation of the author. Tables and figures were to be excluded for ease of sorting. Moreover, at times a table may contain numerous YESes and Noes or Ys and Ns representing the answers of respondents. Appendices usually are also not reflective of the style of writing of an author. Consider only the textual part of the article with the above exceptions since that part seemed to be the best part for judging the word use pattern of an author. In the case of hyphenated words, follow the following rules.
- If the hyphen joins a prefix, such as coordination, remove the hyphen, and consider the word as coordination
- In other cases, such as short-term. Remove the hyphen, and consider the combination as two different words
- Convert the punctuation marks into spaces,
- Convert all spaces into line breaks.
- Convert all upper-case letters into lower-case letters
- Make sure that the file has converted into a pure word file
- Sort the file alphabetically and save it as a text file
- Run the file through a small program that can count the frequencies of word occurrence. The program will take the text file as its input and reproduce the text file with the corresponding frequencies as its output.
- Convert the file into a table
- Sort the table according to descending frequencies
- Add one column to the table for the rank
- Compute rank x frequency
- If the product of rank and frequency is found to be more or less the same, the Law is verified.

2.6.3. Uses

This law is taught in some LIS courses in India. It has been the subject of study in Master's level dissertations as well as theses. Ray [22, 23]in his thesis has applied this law of Zipf basing the words of Gitanjali. The ranking of the words helps generate automated abstracts as well as keywords.

2.7. Third Law - Definition

The length of a word is very closely related to the frequency of its use. The greater the frequency, the shorter the words.

2.7.1. Explanation

This law relates to the length of words. In the case of this law, word length means the number of letters present in a word. For example, the word length of ‘equation’ is 8 as there are eight letters. Here the unit of measurement is a letter and not a millimetre or centimetre. You might have noticed that words are of various lengths. The words of the shortest length such as a, I, etc are few. The number of words with greater and greater lengths goes on increasing up to a certain point beyond which the number comes down and finally becomes zero [30]. In Table 4 we see that the number of words of length 3 is maximum. As the word length increases, the number of words decreases. Beyond 14-word length, the frequency is found to be zero. In the English language, there are words whose length goes up to 20 or a bit beyond. But they are very few in number.

Table 4: Word Length vs. Frequency of Occurrence

Word Length	Frequency
1	36
2	309
3	362
4	252
5	213
6	179
7	198
8	141
9	187
10	91
11	65
12	27
13	4
14	8
15	0
16	0
17	0
18	1
19	0
20	0

- Take a piece of writing in English containing not less than 5,000 words. The writing can be an article, a short story, a novelette, a part of a novel, or even technical writing.
- Scan the selected writing with an optical character recognition (OCR) software viz. OmniPage Pro.
- Save the file in a suitable software package such as Microsoft Word for Windows
- Check the file with the original to ascertain accuracy.

2.7.2. Verification

Follow the steps nos. i to xii as given under the 2nd Law. Thereafter, a short program is to be written to count the word lengthwise. Once that is done, prepare the Table as given above. The Table itself will provide the indication as to the verification of the Law.

2.7.3. Use

In many software packages like CDS/ISIS, it is necessary to specify the word length. The study of word lengths gives us an idea of the maximum length of words in various languages. Accordingly, word lengths can be specified in the computerization processes of various LIS activities like database creation, index generation, and so on.

2.8. LOTKA'S LAW

Bradford's law deals with the scatter of journal literature devoted to a particular subject wherefrom we get an idea of journal productivity as well. Zipf's laws are devoted to the study of words from various angles using statistical methods. Lotka's law studies the author's productivity. In 1926, Alfred J. Lotka, a statistician of the Metropolitan Life Insurance Company, USA, became engrossed with the idea of determining, 'if possible, the part which men of different calibre contribute to the progress of science. For this purpose, he used the index of Chemical Abstracts for the years 1907-1916 and developed a listing of A and B names [i.e. the names starting with the letter A and B] and the corresponding number of papers each author produced. The same procedure was applied to Auerbach's Geschichtstafeln der Physik till the year 1900 using complete coverage. After studying the productivity of the authors, he was surprised to see that the productivity of the authors can be expressed with a simple equation.

2.8.1. Equation

The equation derived from the study is $x_n y = c$ where x stands for the number of contributions, y for the number of authors, and c is constant. Lotka found the value of n as 2. Since then, many have worked in this area. References to these works may be seen in Egghe, Ravichandra Rao; also Egghe and Ravichandra Rao have developed a model to explain the distribution of productivity based on the fractional counting method. Lotka's law was derived based on the simple counting methods as explained above.

2.8.2. Explanation

It has been observed that more authors contribute a smaller number of papers. If you go through the author index of Indian Library Science Abstracts 1992-1999 or 2000-2005, you will notice that the largest number of authors have contributed only 1 paper, less number have contributed 2 papers, still less number contributed 3 papers and so on. If you take a count, you may find that around 100 authors have contributed 1 paper each, and only about one or two authors have contributed 10 papers or more. From the formula, the productivity of authors producing 1, 2, or more articles, can be estimated as below.

Table 5: Distribution of Papers according to the Number of Authors

No. of Papers	No. of Authors
1	1024
2	256
3	114
4	64
5	41
6	28
7	21
8	16

9	13
10	10

2.8.3. Verification

For the verification of the law, you are to follow the following steps.

- Take an author index of an abstracting or indexing periodical. You can take the whole A to Z index if the number of entries is manageable. Otherwise, you can take part in the index.
- Count the number of entries against each author, and write down the number against his name as given in Table 6. If this data is entered into a computer, sorting the data in column 3 will be very easy.
- From the sorted data in column 3, find out the number of authors who have contributed one article, two articles, and so on.
- Tabulate the data as in Table 5.
- Taking the value of n as 2, check whether the data fit into Lotka's law. If it does not, you are to try with different values of n. It may be more than 2 or less than 2. By the trial-and-error method, you may arrive at a value that will bring the figures quite close to the actual values. Otherwise, you may follow Sen's method or Pao's method [18] to find out the value of n. Pao's method involves a great deal of mathematical calculation and students with very good mathematical backgrounds can apply the same.

Table 6: Author Productivity*

Authors	Entry No/s. of Contributions	No. of Contributions
Abbahu (G E P)	2599	1
Abbas (S M)	2738	1
Abbas Ibrahim	538	1
Abbulu (G E P)	917	1
Abdella (Woinshet)	3036. 3037	2
Abdul Azeez (T A)	1215	1
Abdul Jaleel (T)	1119	1
Abdul Majeed Baba	0595, 0956, 0929	3
Abdul Rashid	0311, 0312, 0743, 1477,	5
Abdur Rauf Meah (Md.)	2511	1
Abid (Abdelaziz)	2453	1
Abideen P (Sainul)	0461	1
Abidi (Syed A H)	2504	1
Abifarin (Abimbola)	2233	1
Abraham (Deborah V H	423	1
Abraham (J)	0424, 0466, 0744, 1015, 1726, 2031, 3011	7

* Columns 1 &2 reproduced from Indian Library Science Abstracts 1992-1999

2.8.4. Use

It helps to determine the highly productive, moderately productive, and less productive authors in a subject. It needs to be mentioned here that the book 'Power Laws in the Information Production Process Lotkaian Informetrics' brought out by Academic Press in 2005 under the editorship of Leo Egghe dwells on the subject at length. It presents informetric results from the viewpoint of Lotkaian size-frequency functions. The theory has been developed in the framework of Information Production Processes (IPPs). Its relationship with the law of Zipf applications has also been indicated in a number of fields.

2.9. IMPACT OF BIBLIOMETRIC LAWS

As it is well known the three fundamental laws of bibliometrics are its foundation. In simple terms they are; Bradford's Law of Scattering, Zipf's Law on the frequency of word occurrence, and Lotka's Law of Scientific Productivity. Bradford's distribution often can be fruitfully used to estimate the total size of the bibliography and the periodicals that should necessarily be included in the list of items to be covered in a library and information centre, and more precisely Ranking of Periodicals, and suggesting core periodicals a library should subscribe. In the beginning and at a stage when bibliometrics studies were very popular, every paper would use Bradford's Law for ranking periodicals and was one of the common denominators of study in most of the papers.

So, naturally, this law is applied to study not only the scattering of publications but also in other spheres of activity also. By analyzing the R & D expenditure, there is a heavy concentration of manpower deployed, papers published, patents filed, and processes/products developed in the core in-house R & D units. This shows the superiority of the core not only in the R & D expenditure but also, in other yardsticks too.

Zipf's law can be effectively used in the generation of semi-automatic indexes useful for an information retrieval system. Its use has increased tremendously with the emergence of natural language indexing of textual matter, especially in electronic form. Zipf's law provides a measure of the richness in the vocabulary of an author. This technique can be used for deciding the correct authorship of disputed works. For example, if there is a difference of opinion as to the correct author of a work, the word predilections of the attributed authors can be analyzed either manually or using a computer. Once the frequencies of occurrence of favorite words are decided, the disputed text can be analyzed to see similarities and thereby decide the author conclusively. The
law is also used for identifying words that are more frequently used in different foreign languages.
These words are taught first in the instructional programs of foreign languages.

Lotka's proposition led to a whole gamut of studies on scientific productivity. Such productivity studies have gained momentum in the post-second world war period. Scientific productivity studies have been made from different angles. The impact of social change on scientific productivity, the relationship of publication output on scientific recognition, identification of elites in different disciplines, the occurrence of discoveries in different cultures etc. The last two laws are finding their application more in the current stage of web and electronic environment whereas bibliometrics is gradually giving away to scientometrics and other metrics studies on the evaluation and assessment of individual, institutional and national productivity and impact of scientific research

2.10. SUMMARY

Bradford's law is one of a number of similar patterns observed in a variety of situations. In bibliometrics, two other laws relating to author productivity of scientists and word frequencies in texts that go by the name of Lotka's Law and Zipf's law have a similar pattern where a few *sources* produce many items. Similar patterns have also been seen in economics and geography in the distribution of wealth or populations in cities. One might like to know why a ranked list of journals or citations, money, populations of cities, etc.) follow similar patterns. It is beyond the scope of this chapter to discuss these aspects. However, the present understanding is that these similarities are statistical in nature and that they arise under conditions of *cumulative advantage.* This term means that the underlying processes reinforce each other. This is sometimes also called the "success breeds success" principle. The empirical relationship observed by Bradford has also been sought to be expressed through a variety of models. Some of these features will be discussed in another lesson on Rank frequency models.

Three classical laws of bibliometrics have been discussed above. Of all the laws Bradford's law has found wider application. We shall discuss more this in the Conclusion section of Bradford Distributions (Unit 2). Of the three laws, it is generally seen that the largest number of papers are appearing on Bradford's law followed by Lotka's law and Zipf's laws. Compared to Bradford's law and Lotka's law, conducting studies with Zipf's laws is time-consuming and tiring as the laws involve thousands and thousands of words. Nowadays these laws are being studied using computers. The uses of Lotka's law and Zipf's laws have so far remained limited. From India, a large number of articles and theses appear on bibliometrics. Hardly any of them generate a new bibliometric law, find a new use for the laws, or provide a new method or mathematical formulation of the laws. It is heartening to note that a student of the University of Calcutta is applying Zipf's laws in authorship attribution. The outcome of his study is encouraging. To this day there was no good course material on the laws. It is hoped that with these course materials they will be able to grasp the laws and work with the laws with ease.

2.11. MCQ QUESTIONS

1. Who propounded the law of scatter? A. George Kingsley Zipf B. Samuel Clement Bradford C. Jean-Baptiste Estoup D. None of the above

2. Bradford suggested one of the following relations to describe a scattering phenomenon A. f(x) = a*b x (f(x) is the # of articles in x the most productive journal) B. f(x) = a*x b (f(x) is the # of articles in x the most productive journal) C. F(x) = a + b log x (F(x) is the cumulative # of articles in x most productive journals) D. None of the above.

3. 1. Who showed that Bradford's verbal formulation is different from his graphical formulation A. George Kingsley Zipf B. Samuel Clement Bradford C. B. C. Vickery D. Above all

4. Why is Leimkuhler's formulation of Bradford's law disadvantageous for the practical documentalist? A. It is difficult to understand B. It requires tedious statistical computation C. It requires tedious statistical computation D. None of the above

5. Who showed that Bradford distribution is quite close to Zipf distribution? A. Abraham Bookstein B. K G Kendall C. M G Kendall D. None of the above

6. Shepherd's citations published in: A. 1873 B. 1973 C. 1773 D. 1673

7. Many bibliometricians derived the equation for Bradford's law. True/False

8. The verbal formulation of Bradford's law differs from its graphical formulation. True/False

9. Bibliometric distributions can generally be expressed through algebraic expressions. True/False

10. Please arrange this in the correct order: Bradford's law A. 1934 B. 1968 C.1970 D. None of the above

11. Please arrange this in the correct order: Brookes equations for Bradford's law A. 1934 B. 1968 C. 1970 D. None of the above

12. Please arrange this in the correct order: Naranan's viewpoint on Bradford's law A. 1934 B. 1968 C. 1970 D. None of the above

13. For petroleum literature Cole found the value of b as __________ .A. 4.3 B. 0.43 C.043 D. None of the above

14. The constant β occurs in - - - formulation A. Leimkuhler's B. Brookes' C. Cole's D. None of the above

15. Bradford's law is applicable for -- -- -- periodicals A. Cultural B. Scientific C. Educational D. None of the above

16. For the verification of which law author index is used? A. Lotka's law B. Bradford's law C. Zipf's law D. None of the above

17. Ranked list of authors A. Zipf's law B. Bradford's law C. Lotka's law

18. Ranked list of words A. Zipf's law B. Bradford's law C. Lotka's law D. None of the above

19. For the verification of which law author index is used? A. Lotka's law B. Bradford's law C. Zipf's law D. None of the above

20. Lotka's Law deals with Journal Productivity. True/False

2.12. SHORT QUESTIONS

What does Zipf's law?

Why is Zipf's law important?

What is Lotka's curve?

How is Bradford's Law calculated?

How do you use Bradford's law?

2.13. LONG QUESTIONS

State three classic laws in bibliometrics and elucidate how these laws are useful in library management.

What is Bradford's Law? How can the degree of scattering of journals be measured?

Discuss the significance and application of Bradford's law of scattering.

Which bibliometrics law describes the frequency of publication by authors in a given field?

What is the formula of Zipf's law in NLP? What is a rank in Zipf's law?

KEYWORDS: Zipf's law; Lotka's law; Bradford's law

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UNIT 3
DATA SOURCES AND SOFTWARE TOOLS FOR BIBLIOMETRIC/SCIENTOMETRIC STUDIES

3.0. OBJECTIVES

- To understand the parameters used for bibliometric analyses.
- To know various bibliographic and citation databases used as data sources in bibliometric studies
- Appreciate the relative merits and limitations of these databases
- Familiarize with some of the software/tools for bibliometric analysis
- To understand the features of a few software/tools.

3.1. OUTCOME OF LEARNING

You will learn knowledge about different data sources and software tools. You learnt only a few databases and a few software tools.

3.2. STRUCTURE OF UNIT

- Introduction
- Why researcher publish?
- Data Sources for Bibliometrics Studies
- Case Studies on Comparison of Citation Databases
- Conclusion on data sources for bibliometric studies
- Software/Tools for Bibliometrics Analyses
- Summary
- References

3.3. INTRODUCTION

Bibliometrics, as you are aware, is a field of study which deals with methods to quantitatively analyze scholarly literature. As technique bibliometrics is used basically for studying a) Scholarly communication: tracing the history and evolution of ideas from one scholar to another; and b) Scholarly influence: quantifying the impact of articles, journals, scholars, institutions, nations, etc. Both these purposes of bibliometrics have been based on assumptions. They are:

- Scholars communicate their findings by publishing articles
- Scholars cite earlier related works of others (and sometimes of their own) in their articles to acknowledge the intellectual debt and to witness the use of information. There are other reasons for citation which will be dealt with later.

3.4. WHY DO RESEARCHERS PUBLISH?

Scholars consider publishing their works or ideas a paramount activity. The catchphrase 'publish or perish' is quite popular among scholars and indicates the kind of importance given to publishing activity. In fact, as Merton (1957) says, publishing research of their work is an obligation on the part of the scholars. Reward system for the scholars like promotion, recognition, awards and so on is normally based on their publication activity. The three purposes served by the scholarly publication are: spreading scientific findings, protecting intellectual property, and gaining popularity among peers. The publications of scholars are the basis for studies adopting bibliometric techniques. The common metrics used in bibliometric studies include but are not limited to the following:

- Article counts with attribution by country (see example 1), by the institution and by the author (see example 2 and example 4)
- Impact factors (see example 3)
- H-index and other indices (see example 4)
- Citation scores at article level (See example 4)
- Co-citation scores ((the number of times that two papers are cited together in a single paper) (see example 5)
- Visitor numbers (or other info) for online articles
- And many others… e.g., blog entries, tags, etc.

All of these techniques combine to give more detailed and more effective measurements. Results are presented in various forms, such as mapping, in order to depict the relationships between participants and expand the means for analysis. In this chapter, you will learn about a few data sources and software tools commonly used in bibliometric studies. Please note that we do not intend to provide a comprehensive list of all possible sources/software. The lists, given in the subsequent sections, are only illustrative.

3.5. DATA SOURCES FOR BIBLIOMETRICS STUDIES

Data collection for bibliometric study has to be done with care and diligence. The question is where one would get the details about publications? How to collect publication details - say, by authors, by institutions, by nations and so on? How to get citation data for bibliometric analyses?

Data for Bibliometrics studies are to be invariably collected from publications. There is a variety of publishing routes these days, and those in different contexts will value different types: journal articles, monographs, blogs & tweets. Traditionally journals are the most valued source and they continue to be so. Hence many of the bibliometric studies still revolve around journals. Recent trends in Bibliometric studies show the use of other digital sources as well. But collection of data for bibliometric studies directly from publications is next to impossible task for individual researchers. Hence one has to depend upon some good source from which the raw data could be culled-out. The decision about the data source goes a long way in the output of the study.

Going by the literature on the field one could say that data sources for bibliometrics are: Questionnaires, Bibliographic databases, Citation databases, Journal indices, Library catalogues and Information systems, Institutional information systems, National databases and so on. Normally, results of the bibliometric analyses are amenable for valid and acceptable generalization only when the data collected is considerably large. The method of collecting data through questionnaires and personal inspection of the original publications are thus considered to be impractical in many situations.

3.6. Databases as data sources

The data source for a bibliometric study is mostly a database. Using of multiple databases for a study is also on the rise. Databases developed by commercial establishments or by public or private institutions form the sources of data for bibliometric studies. One may find one or more databases for every established academic discipline. The following are some of the widely used data sources for bibliometrics (the list is just illustrative and not comprehensive):

- **Chemical Abstracts Service (CAS):** CAS is a division of the American Chemical Society. Its objective is to find, collect and organize all publicly disclosed substance information. Arguably, it is the largest database of chemical information. It covers the publications that appear in the form of books, journal articles, patents, conference proceedings, and so on. Its coverage is from 1907 onwards.
- **CiteseerX:** It is an evolving scientific literature digital library and search engine that has focused primarily on the literature in computer and information science. CiteSeerx aims to improve the dissemination of scientific literature and to provide improvements in functionality, usability, availability, cost, comprehensiveness, efficiency, and timeliness in the access to scientific and scholarly knowledge.
- **Compendex**: It is a product of Elsevier. It is the most comprehensive bibliographic database covering all engineering disciplines. It covers peer-reviewed journals, conference proceedings, and trade publications. The coverage period starts from 1870 onwards. With 15 million records across 190 engineering disciplines, Compendex delivers the comprehensive, precise information and insights that researchers need. It is available on the Engineering Village platform. It covers more than 1000 journals.
- **ERIC**: The Education Resources Information Center (ERIC) - is an online digital library of education research and information. ERIC is sponsored by the Institute of Education Sciences (IES) of the U.S. Department of Education. ERIC provides ready

access to education literature to support the use of educational research and information to improve practice in learning, teaching, educational decision-making, and research. ERIC provides unlimited access to more than 1.4 million bibliographic records of journal articles and other education-related materials, with hundreds of new records added multiple times per week. If possible, links to full text in Adobe PDF format are included. Within the ERIC Collection, you will find records for journal articles, books, research syntheses, conference papers, technical reports, policy papers, and other education-related materials

- **Google Scholar**: In 2004 Google Inc. introduced Google Scholar a citation database for searching scholarly literature. Google Scholar is a freely available citation database. Because free availability and indexing of different forms of scholarly information (book chapters, conference proceedings, books, pre-print servers, and other forms) other than journals have made Google Scholar a major data source for citation analysis and scholarly information for researchers, librarians, and other stakeholders.
- **Inspec**: The Inspec database contains 13 million abstracts and specialized indexing to the world's quality research literature in the fields of electronics, computer science, physics, electrical, control, production, and mechanical engineering since the late 1960s. It contains an index and abstracts of articles selected from nearly 5000 scientific and technical journals (1600 of which are indexed from cover to cover), some 2500 conference proceedings, as well as numerous books, reports, dissertations, and scientific videos. It is published by The Institution of Engineering and Technology, Stevenage, Herts., U.K.
- **Library and Information Science Abstracts (LISA)**: LISA (maintained by ProQuest) is an international abstracting and indexing tool designed for library professionals and other information specialists. LISA currently abstracts over 440 periodicals from more than 68 countries and in more than 20 different languages, selected conference proceedings, book reviews, and research report series. The temporal coverage is from 1969 onward. It indexes approximately around 7000 publications annually. In considering candidate journals at the scholarly end, the editor takes account of a range of standard criteria, e.g., publishing standards, timeliness, editorial content, peer review, international diversity of authorship, and citation data.
- **MathSciNet**: It is an electronic database of reviews, abstracts, and bibliographic information for much of the mathematical sciences literature. Over 100,000 new items are added each year, most of them classified according to the Mathematics Subject Classification. MathSciNet® contains over 2.8 million items and over 1.6 million direct links to original articles. Bibliographic data from retro digitized articles dates back to the early 1800s. Reference lists are collected and matched internally from approximately 500 journals, and citation data for journals, authors, articles, and reviews is provided. This web of citations allows users to track the history and influence of research publications in the mathematical sciences.
- **PubMed**: National Library of Medicine (NLM), United States has been indexing the biomedical literature since 1879, to help provide health professionals access to information necessary for research, health care, and education. What was once a printed index to articles, the Index Medicus became a database now known as MEDLINE. MEDLINE contains journal citations and abstracts for biomedical literature in many languages from around the world. Since 1996, free access to MEDLINE has been available to the public online via PubMed. It comprises more than 22 million citations for biomedical literature from MEDLINE, life science

journals, and online books. Citations may include links to full-text content from PubMed Central and publisher websites. About 5 lakh records are added every year. Over 5400 biomedical journals were published in the United States and 70 other countries and dating back to the 1940s and were updated 5 times/week.

- **Scopus**: It is an abstract and citation database of peer-reviewed literature with smart tools that track, analyze and visualize research. The features of Scopus are as follows: Over 20,500 titles from 5,000 publishers worldwide; Contains 49 million records, 78% with abstracts; Includes over 5.3 million conference papers; Provides 100% Medline coverage; and Interoperability with Science Direct, Engineering Village, and Reaxys, is a unique chemistry workflow solution. Its covered only English language items since 1995.
- **Web of Science (WoS)**: Thomson Reuters (formerly ISI) Web of Knowledge is today's premier research platform for information in the sciences, social sciences, arts, and humanities. It is a suite of databases containing about 25 different databases. The most important among them are Science Citation Index, Social Science Citation Index, and Arts & Humanities Citation Index. The database includes the following: 23,000 academic and scientific journals (including Web of Science journal listings); 23,000,000 patents; 110,000 conference proceedings; 9,000 websites; Coverage from the year 1900 to present-day (with Web of Science); Over 40 million source items; and Integrated and simultaneous searching across multiple databases. Web of Science has been a subject of criticism also. The most important among them is its bias towards English and US. It is said that it does not cover even 10% of India's scholarly journals. Another limitation of WoS is that does not cover books, dissertations and theses, patents, and other kinds of literature.

3.7. KINDS OF DATA SOURCES

At this juncture, as a student of bibliometrics, it may be useful for you to know a subtle difference between **Bibliographic databases** and **Citation databases**. Selection from these kinds of database depends upon the kind of bibliometric study to be conducted.

- **Bibliographic databases** or Indexes are good for finding additional materials written about a particular subject. Just like a bibliography at the end of a paper, a bibliographic database can provide you with citations for further study and documentation on a subject. They contain bibliographic information (title of the article, journal name, author, date of publication, volume #, issue, page #, etc.) about various types of publications and formats (print, video, audio, software, etc.). Among the databases listed above - CAS, Compendex, ERIC, LISA, Inspec, MathSciNet, and Pubmed are basically bibliographic databases. One can't use these databases for studies that call for cited data.
- **Citation Databases**: On the other hand, the **Citation databases** slightly differ in their content from that of bibliographic databases. Citation, as you are aware, is a best practice among the scholarly community to acknowledge the ideas taken from earlier works. The acknowledgment will be in the form of references at the end of the article. Citation databases are specific for presenting each article included in the database also by the respective list of references in addition to bibliographic records. These lists of references are called cited references. The search according to cited references is more complete because it enables the target to follow up on a particular topic through all articles on the topic which are included in the database. Namely, citations are presumed to be related to the topic of the current paper by their contents, irrespective of the reasons for their citing (i.e. favorable, such as paying credit to, or for criticism

and correction). In addition to allowing for literature searching according to topics, citation databases provide data on the number of citations received by a particular journal, author, or paper. CiteseerX, Web of Knowledge, Google Scholar, and Scopus are examples of Citation databases. The databases, like the ones listed above, contribute to the bibliometric studies in two different ways: a) they act as reliable data sources for bibliometric studies, and b) databases do provide some analytical tools for bibliometric studies. It will be examined below.

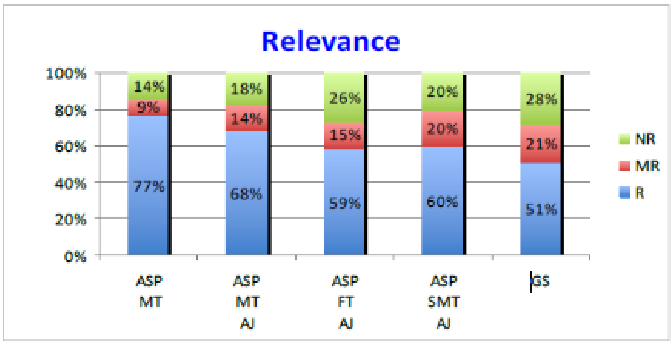
- **As a source of data**: Different bibliometric studies can be conducted using the databases as discussed in various studies (Stefaniak, 1987; Deogan, 1987; and Hood & Wilson, 2003). The following are different fields/data elements in the databases on which one collects data for bibliometric studies.
- Subject-oriented fields (e.g. classification codes, descriptors, identifiers, keywords, words in the title, words in the abstract, words in the full text).
- Type of publication (e.g. journal paper, conference paper, book, patent, report, etc.).
- Source (e.g. journal-title, CODEN, ISSN number, ISBN number, patent number, year of publication, volume, number of issues, pages, name of publisher, place of publication).
- Responsibility (e.g. name of authors (see example 4), editors, translators).
- Geographical and institutional information (e.g., country of its editor, name and corporate affiliation of the authors – the name of organization, city, country (See example 1)).
- Language(s) of publication.
- Secondary source (e.g. year, volume, and the number of the abstract).
- Citations or references (eg. in the three ISI citation databases) (see example 4).
- **Analytical tools**: Manual bibliometric analysis is often cumbersome and tedious in nature. Thanks to the developments in ICT. The databases provide fast, inexpensive, advanced, domain-dependent, reliable, and reproducible analytical tools. Article counting on different attributes, removal of duplicate items (when multiple sources are used), frequency analysis, defining of subset, ranking on specific criterion, h-index calculation, link analysis, mapping, visual representation, integration with external programs, etc., are all possible with modern databases.

3.8. CASE STUDIES ON COMPARISON OF CITATION DATABASES

We have seen in the previous sections that there are a number of databases – bibliographic and citation. The number is growing. The bibliometric researchers are always confronted with the question of which one is the better among their rivals. A few studies have been conducted to compare the databases. The gist of those research works is presented here as case studies.

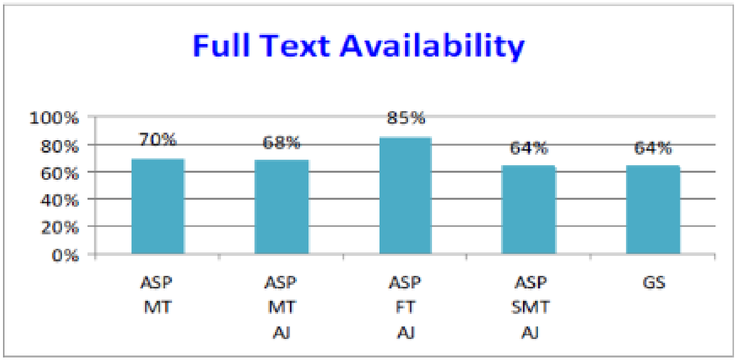
3.8.1. Case Study 1

Hsieh-Yee and Coogan compared two databases in their work '**Google Scholar vs. Academic Search Premier: What Libraries and Searchers Need to Know.** They framed four different questions for searching the databases. The results were analysed. Only the top10 items of each search set are examined for relevance, full text availability, full text effort, currency, and overlap. The results are as follows in the form bar graphs[1] which are self-explanatory:



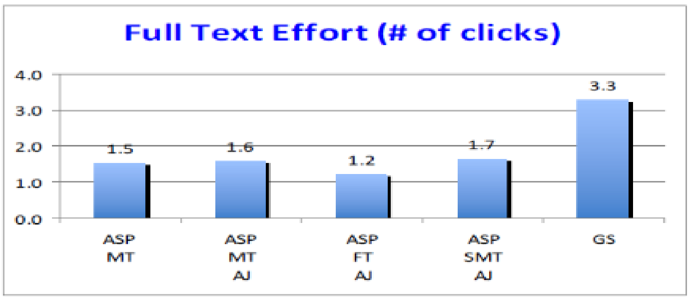
Best Relevant Results: ASP MT (77% R)
Worst Relevant Results: GS (51% R, plus most NR, most MR)

Fig 1: Relevance



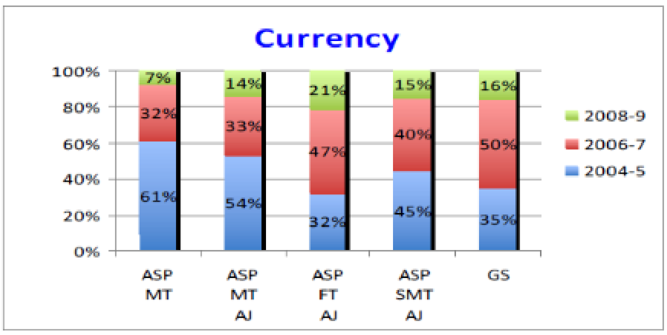
Most FT Availability: ASP FT AJ (85%)
Second best: ASP MT (70%)
Least in FT Availability: GS, ASP SMT AJ (64%)

Fig 2: Full text availability



Least effort needed: ASP FT AJ (1.2 clicks)
Most effort needed: GS (3.3 clicks)

Fig 3: Full Text Effort



2004-05: ASP MT (61%)
2006-07: GS (50%)
2008-09: ASP FT AJ (21%), although neither system retrieves many

Fig. 4: Currency

The authors conclude as follows:

ASP outperforms GS in terms of:

- Higher Relevance (especially in metadata-only searches)

- More FT availability and easier access to FT
- More effective advanced searching

GS outperforms ASP in terms of:

- "Newer" items (a slight advantage when limiting by date)
- GS retrieves more items, plus more ASP items are indexed by GS than the other way around.
- Covers some types of materials not readily found in library databases (books, grey literature, materials in institutional repositories)

Top 10 results:

- Similar searches in ASP and GS produce very differently top 10 results.

Recommendations:

- ASP is a good primary tool; GS is a good supplement.
- Searchers may want to use both systems to have the best of both worlds.

3.8.2. Case Study 2

Aguillo's study is on 'Is Google Scholar useful for bibliometrics? A webometric analysis. The results of the study were reported in the Scientometric journal in 2011. Without looking into the methodology used in the study, we will just see the results which would be sufficient for our purpose here. Some of the results of the study are as follows:

- Google Scholar was not designed as a direct competitor to the other citation databases, being this extra feature (citation counts and links) mainly oriented to improve the searching experience.
- It is really a huge database and Google is clearly intends to enlarge its coverage, not only by adding additional sources but by collecting every type of scientific material available on the public web.
- Our suggestion is that the use of Google Scholar for bibliometric or evaluation purposes should be **done with great care**, especially regarding the items not overlapping with those present in the Scopus or WoK citation databases.
- However, the recent launching of a new service called Google Scholar Citations and the huge update and revamping of Microsoft Academic Search is changing the level of commitment of these engines to citation analysis, especially for personal description and evaluation purposes.
- The possibilities open to authors to correct errors, modify profiles and combine results, in a typically Web 2.0 fashion, make these new offerings a serious and free competence to Researcher ID (ISI Thomson) or Scopus Author Identifier services.

3.8.3. Case Study 3

Meho and Yang have conducted a study on 'Impact of Data Sources on Citation Counts and Rankings of LIS Faculty: Web of Science Versus Scopus and Google Scholar'. The suggestions made in the study are quite useful in the present context of this chapter. Among many, only some of them are reproduced here:

- The study found that the addition of Scopus citations to those of WoS could significantly alter the ranking of authors.
- The study also found that GS stands out in its coverage of conference proceedings as well as international, non-English language journals, among others. Google Scholar also indexes a wide variety of document types, some of which may be of significant value to researchers and others.

- The use of Scopus and GS, in addition to WoS, reveals a more comprehensive and accurate picture of relationship of LIS with other fields.

3.9. SOFTWARE/TOOLS FOR BIBLIOMETRIC/SCIENTOMERIC ANALYSES

Quantification is important in all aspects of life. Even in scholarly world, the academic and research activities need to be measured. Bibliometrics has become a dominant tool for measuring the value of research activity. Collecting and analyzing huge amounts of data for bibliometrics is not always an easy task. Thanks to technology. Now we have very qualitative and reliable databases. More than that there are a number of analyzing tools also. These tools are heavily used by bibliometricians. In this section, a bird's-eye-view is presented about the software/tools available for bibliometric analysis. We do not intend, as we proposed in the previous section also, to provide a comprehensive list of all products for want of space and time. Only popular products have been discussed. They have been discussed in alphabetical order of their names to avoid any bias.

3.9.1. BibExcel

- It is freeware for academic and non-profit use.
- It is developed by Olle Persson of Sweden.
- Its popularity lies in the fact that it can do most types of commonly done bibliometric analysis. Frequency distribution (Authors, Titles, Citations, or any field specified), and Co-occurrence analysis (includes Co-citation analysis, Bibliographic coupling, Co-author analysis, and Co-word analysis) are the most widely used functionalities in BibExcel.
- One unique feature of the tool is it uses two counting methods – Whole Counts and Fractional Counts. The distinction between the two is not difficult to understand. For example, for a three-authored article, while the whole count method assigns one count for each author; the fractional count method assigns one-third of the count for each author. Both these counting methods are in vogue in bibliometrics.

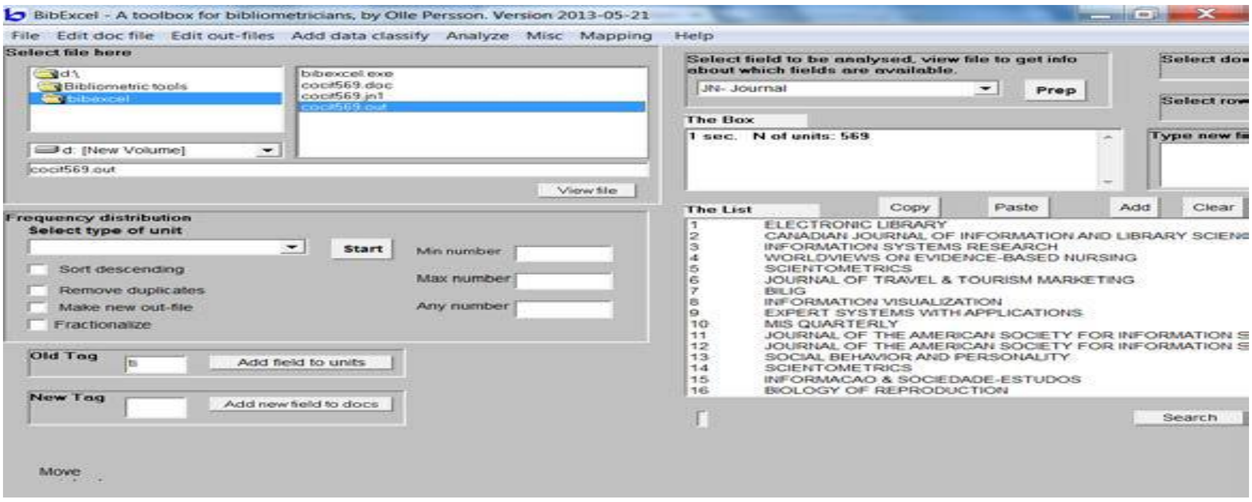


Fig 5: Screenshot of BibExcel

- A useful feature in Bibexcel is the one that enables us to produce data matrices for export to statistical software. It allows easy interaction with other software, e.g. Pajek, Excel, SPSS, etc.

- The program offers the user a high degree of flexibility in both data management and analysis and this flexibility is one of the program's real strengths. It is, for example, possible to use other data sources than Web of Science, and Bibexcel can in fact deal with data other than bibliographic records.

3.9.2. CITESPACE

- Chaomei Chen created a tool to visualize and analyze trends in scientific literature called CiteSpace.
- It is a free Java application that can be downloaded by users.
- The input data sources for CiteSpace are Web of Knowledge, PubMed, arXiv, ADS, and NSF Award Abstracts.
- A unique feature of CiteSpace is that records from Derwent World Patents Index can also be visualized.

A user guide describes the following steps for visualizing information on CiteSpace:

- **Collect Data** - The primary source for data is the Web of Science, and the default input data format is ISI Export Format.
- **Create a Project** - Consists of two directories: input data files and files generated by CiteSpace for analysis and visualization.
- **Adjust Parameters** - Change time slicing, node types, term sources, term selection, links, pruning, and visualization options.
- **Generate Visualizations** - Available visualizations include Cluster View, Time-Zone View, Show Networks by Time Slices, and Show Merged Networks.

Explore Visualizations

- **Generate Clusters** - CiteSpace uses a spectral clustering algorithm to decompose a network, and the resultant clusters are mutually exclusive (one item to one cluster).
- **Generate Cluster Labels** - Labels can come from three sources: title terms, abstract terms, or index terms.

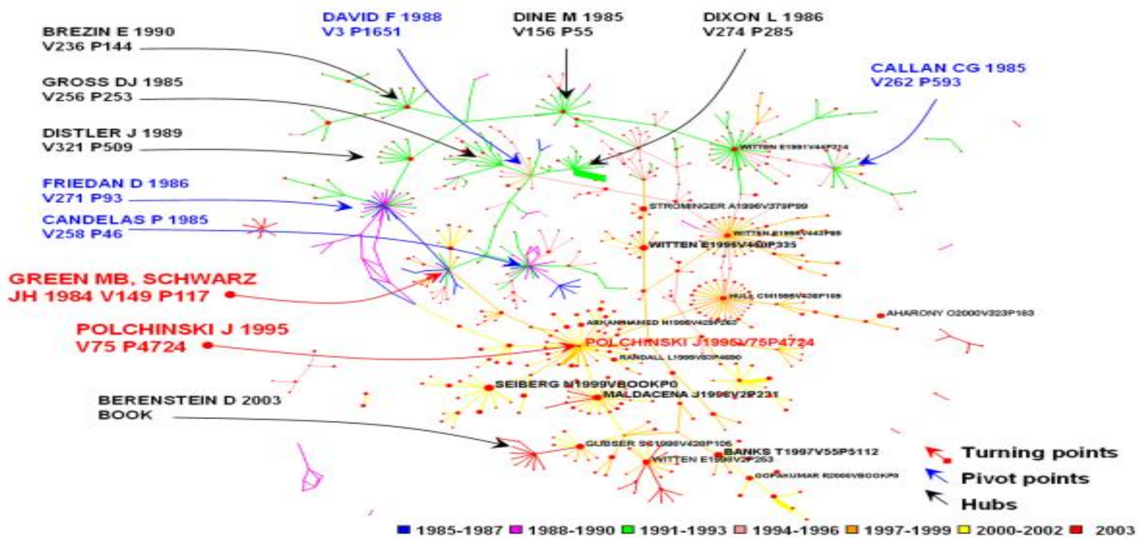


Fig.6: An illustrative example of a visualization generated by CiteSpace

Eigenfactor Score: Journals, traditionally speaking, are the most valued source of information and communication for scientists. They continue to be so. Scholars like to publish their ideas in important journals. Bibliometrics arguably provides some parameters for determining the importance of journals. One such parameter is citations. Eugenfactor is another parameter developed by Jevin West and Carl Bergstrom at the University of Washington. Journals are rated according to the number of incoming citations, with citations from highly ranked journals weighted to make a larger contribution to the eigenfactor than those from poorly ranked journals. The Eigenfactor score is intended to measure the importance of a journal to the scientific community, by considering the origin of the incoming citations, and is thought to reflect how frequently an average researcher would access content from that journal.

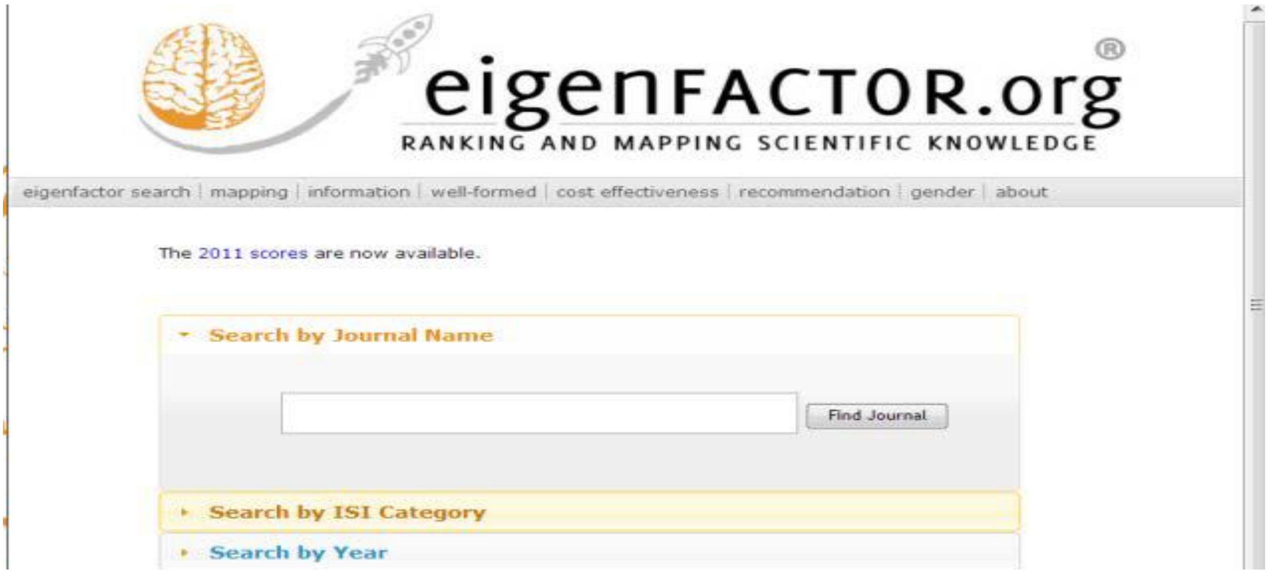


Fig 7: Eigenfactor

The Eigenfactor approach is thought to be more robust than the impact factor metric, which purely counts incoming citations without considering the significance of those citations. While the Eigenfactor score is correlated with the total citation count for medical journals, these metrics provide significantly different information. For a given number of citations, citations from more significant journals will result in a higher Eigenfactor score.

Eigenfactor scores and Article Influence scores are calculated by eigenfactor.org. Eigenfactor scores are measures of a journal's importance. It can be used in combination with H-index to evaluate the work of individual scientists.

3.9.3. HISTCITE

Eugene Garfield, popularly known as the father of Citation Analysis, developed a new software tool called HistCite for individuals to make it easier for individuals to perform bibliometric analysis and visualization tasks. HistCite is a system designed to help selectively identify the significant (most-cited) papers retrieved in topical searches of the Web of Science (SCI, SSCI, and/or AHCI). Once a marked list of papers has been created, the resulting Export file is processed by HistCite to create tables ordered by author, year, or citation frequency as well as historiography which includes a small percentage of the most-cited papers and their citation links. Bibliometric analysis uses bibliographic information such as authors, titles, dates, author affiliations, references, etc., to measure and/or study various aspects. Some typical questions asked by bibliometricians that can be answered by HistCite analysis are:

- How much literature has been published in this field? When and in what countries has it been published? What countries are the major contributors to this field? What are the languages most frequently used by the items published in this field?
- What journals cover the literature of the field? Which are the most important?
- Who are the key authors in this field? What institutions do these authors represent?
- Which articles are the most important?
- How have the various contributors to the field influenced each other?

Fig. 8: Screenshot of HistCite Analysis Window

HistCite can directly be integrated with the Web of Knowledge (WoK) database of Thomson-Reuters, i.e., the data exported from Web of Knowledge can be read into HistCite. In order to utilize this facility, the WoK search results have to be saved in a 'plain text' format. On the other hand, HistCite is not yet ready to read directly from other databases. Bibliographies from other sources can be manually entered into HistCite.

3.9.4. PAJEK

It is software for analyses and visualization of huge networks with a large to a very large number of vertices. Pajek, an unusual name in English, means a spider in the Slovenian language. It was started in the year 1996 and developed into one of the most popular software in the field of visualization. Parjek is a very useful tool in areas like organic chemistry, genealogy, data mining, diffusion networks, etc. It can also be used in bibliometrics to visualize the collaboration and citation networks. Pajek is developed by Vladimir Batagelj and Andrej Mrvar. Some procedures were contributed also by Matjaž Zaveršnik.

3.9.5. PUBLISH OR PERISH

It is a popular software program among scholars that retrieves and analyzes academic citations. It is developed and maintained by A.W. Harzing. It is a valuable program that combats many of the problems of interpreting Google Scholar outputs and allows academics to easily check their own or others' performance. It presents academic outputs quickly and computes excellent citation statistics about each author's work, including an overall 'times cited' score and times cited per year since publication. It uses Google Scholar to obtain the raw citations, then analyzes these and presents the following statistics:

- Total number of papers
- Total number of citations
- Average number of citations per paper
- Average number of citations per author
- Average number of papers per author
- Average number of citations per year
- Hirsch's h-index and related parameters
- Egghe's g-index
- The contemporary h-index
- The age-weighted citation rate
- Two variations of individual h-indices
- An analysis of the number of authors per paper.

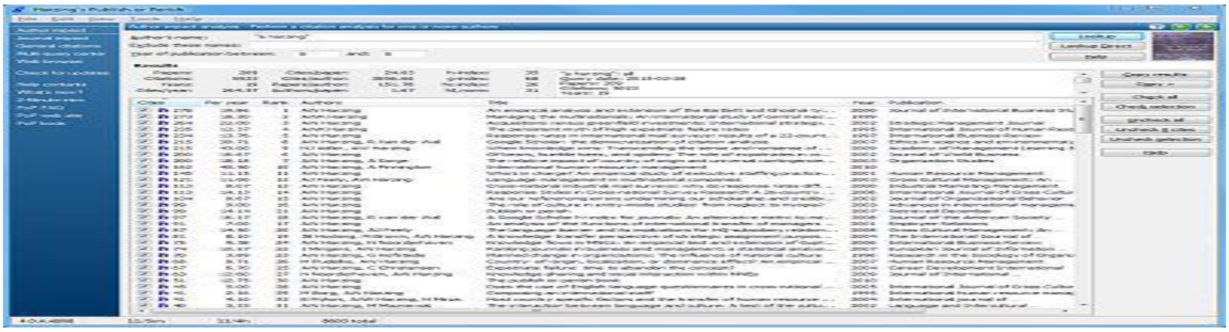


Fig 9: Screenshot of Publish or Perish

The results are available on-screen and can also be copied to the Windows clipboard (for pasting into other applications) or saved to a variety of output formats (for future reference or further analysis). Publish or Perish includes a detailed help file with search tips and additional information about the citation metrics.

3.9.6. SCHOLAROMETER

Scholarometer (previously Tenurometer) is called so as it provides service to scholars by computing citation-based impact measures. It is a social tool to facilitate citation analysis and help evaluate the impact of an author's publications. It is a browser extension/plug-in presently compatible with Google Chrome and Mozilla Firefox. Being a platform-independent tool, it runs on all systems that support Chrome and Firefox. It is an easy tool to use even by a non-expert. Scholarometer helps authors and academic administrators evaluate the impact of someone's research publications, and citation-based impact measures. The figure shows how Scholarometer works.

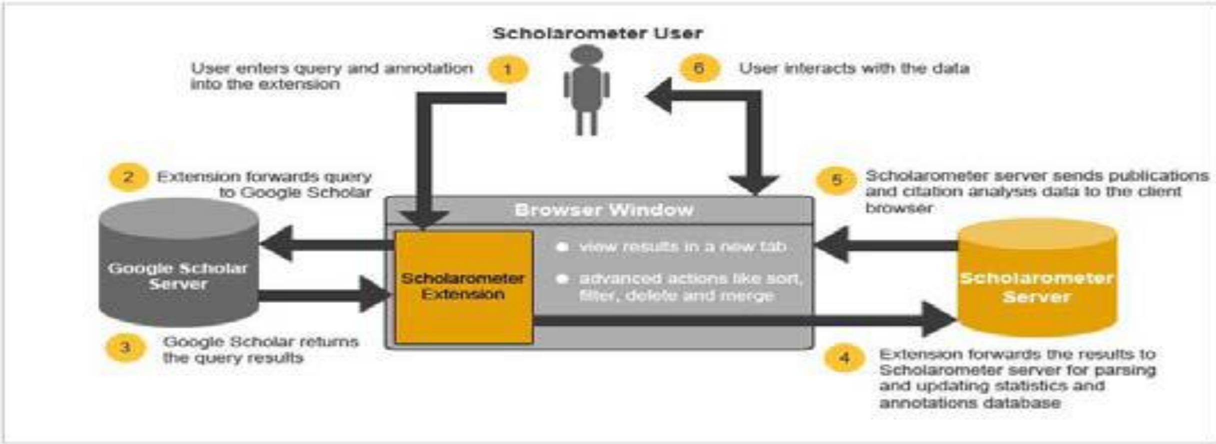


Fig.10: Scholarometer Process

Using Scholarometer, one can compute Hirsch's h-index, Egghe's g-index, and Schreiber's hm index. The latest version of Scholarometer can also calculate the new universal h-index (developed by Radicchi, Fortunato, and Castellano).

One of the useful features of Scholarometer is that it allows filtering, sorting, deleting and live search to compute error-free impact measures. For example, the user can merge multiple versions of the same paper; exclude papers by different authors with the same name, or other noisy data; filter papers by many criteria such as years, disciplines, name variations, and coauthors; and perform live search over the results. The impact measures are dynamically recalculated based on the user's manipulations.

Scholarometer users can save the finding into formats appropriate for local reference management software (e.g., EndNote), or for social publication sharing systems (e.g., BibSonomy). Currently, the system supports the following export formats: BibTex (BIB), RefMan (RIS), EndNote (ENW), comma-separated values (CSV), tab-separated values (XLS), and BibJSON.

3.9.7. VOSVIEWER

VOSviewer is a software tool for constructing and visualizing bibliometric networks. These networks may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations. VOSviewer also offers text mining functionality that can be used to construct and visualize co-occurrence networks of important terms extracted from a body of scientific literature.

Fig.11: Screenshot of VOSviewer software

3.10. SCHOLAR H-INDEX CALCULATOR

Scholar H-Index Calculator (hereafter called just the Calculator in this section) is an add-on for Google Chrome and Firefox which enhances Google Scholar results pages by showing a number of bibliometric data computed using the data appearing on video as input. Once installed, the Calculator works transparently when querying Google Scholar: as soon as you make a query, result pages are enriched with a number of useful data (e.g. the h-index computed on the basis of displayed data), and new functions are available.

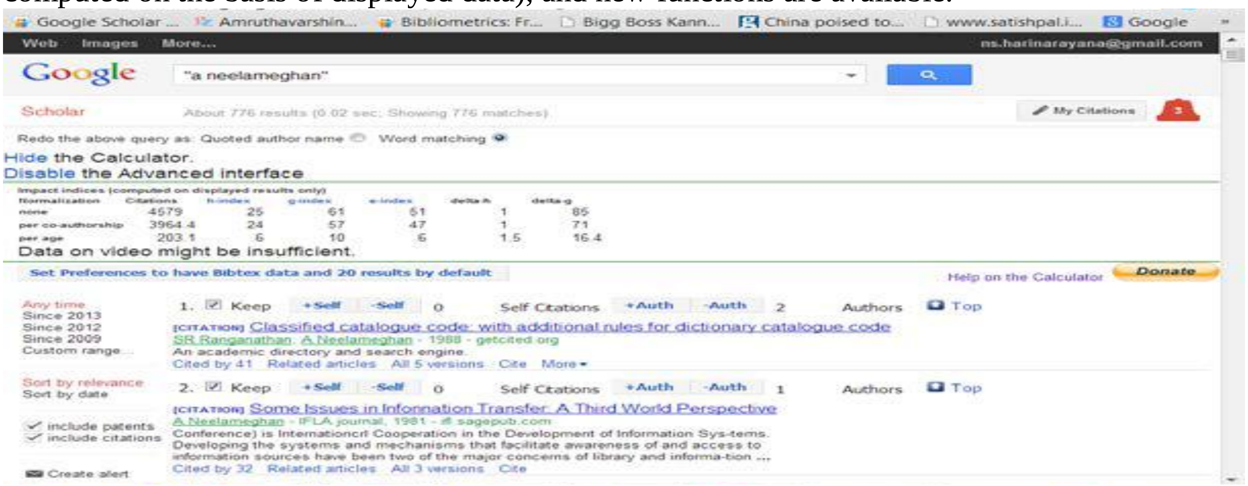


Fig.12: Scholar H-Index Calculator's Output for the author Prof. A. Neelameghan

Using the Calculator is quite easy. After the installation in the browser (Google Chrome or Firefox), the Google Scholar has to be used as usual. Once installed, the add-on displays on top of Google Scholar result pages, the corresponding h-index, g-index, e-index, and other measures of impact for the submitted query. In comparison with other tools, the Calculator has many pleasant features. It is now possible to select or deselect a single paper; manually increase or decrease the number of self-citations; manually increase or decrease the number of authors for a given paper, and to load and save data. One interesting feature of the Calculator is that it provides the measures called delta-h and delta-g. These two values measure the minimum number of citations needed for incrementing the current h-index (g-index, respectively), by 1. delta-h and delta-g are the measures of how difficult would be for the author at hand to increase his/her h and g-index. The latest version (2.3) has added features for normalization per author and normalization per age. In addition, it also has a function called author list refinement.

3.11. SUMMARY

Bibliometrics is a quantification tool that uses scientific communication between scholars as to the basis for analysis. Journal articles, monographs, blogs & tweets are the different media of communication. The bibliographic and citation data for bibliometric analysis are collected through Questionnaires, Bibliographic databases, Citation databases, Journal indices, Library catalogs and Information systems, Institutional information systems, National databases, and so on. There is a subtle difference between Bibliographic databases and Citation databases. Bibliographic databases contain only the bibliographic details whereas the citation databases contain in addition to bibliographic details contain citation data as well. CAS, Compendex, ERIC, LISA, Inspec, MathScinet, and Pubmed are exemplars of bibliographic databases; and CiteseerX, Web of Knowledge, Google Scholar, and Scopus are examples of Citation databases. The selection of data sources for bibliometrics is always a tricky question as each source has its own merits and demerits. A few studies have been conducted to compare the relative merits of these databases. Bibliometrics software and tools are used for bibliographic analyses. The popular bibliometric software/tools are BibExcel, CiteSpace, Eigenfactor Score, HistCite, Pajek, Publish or Perish, Scholarometer, Scholar h-index Calculator, and so on.

3.12. MCQ QUESTIONS

1. Acknowledgement one document gives to another is called ______

2. Acknowledgement that one document receives from another is called ______

3. CiteseerX is a ______

4. Chemical Abstracts Service is published by ______

5. The citation database developed by Google is _______

6. The proprietary bibliographic database in Library and Information Science is ______

7. The Web of Knowledge is currently provided by _____

8. The previous name for Scholarometer is _____

9. h-index is suggested by _______

10. The tool developed by A.W. Harzing is _____

11. Web of Science is a _______A. Bibliographic database B. Citation database C. RDBMS D. Full text database

12. Compendex is published by _____ A. Thomson & Reuters B. Elsevier C. Science Direct
13. h-index is developed by _______A. Eugene Garfield B. L. Egghe C. J.E. Hirsch D. A.W. Harzing

14. Pajek is a _______A. Citation database B. Visualization Software for large networks C. Pattern Recognition D. h-index calculator

15. Google Scholar is a _____A. Search engine for scholarly literature B. Internet browser C. Scholar's directory on the Internet D. h-index calculator

16. Who has developed 'Bibexcel'? A. Olle Persson B. Vickery C. Garfield D. Price

17. When was VOS viewer created in scientometric? A. 2012 B. 2010 C. 2009 D. 2005

18. HistCite was developed by A. S Ranganathan B. Bradford C. Zipf D. Eugene Garfield 19. Biblioshiny is a shiny app providing a web interface for bibliometrix

20. CiteSpace is a freely available Java application for visualizing and analyzing trends and patterns in the scientific literature

3.13. SHORT QUESTIONS

What is bibliometric visualization?

What is BibExcel software?

What is CiteSpace used for?

How do you cite VOSviewer?

What is Histcite?

3.14. LONG QUESTIONS

How do you cite Cytoscape? Explain some of such techniques with examples.

What is meant by perish or publish? Explain in detail.

What is cluster in VOSviewer?

KEYWORDS: BibExcel; VOSviewer; CiteSpace; Histcite

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UNIT 4

BIBLIOMETRICS IN ASSESSING PRODUCTIVITY AND IMPACT OF RESEARCH

4.0. OBJECTIVES

- To know the Bibliometrics impact in the evaluation of scientific research.
- To identify the impact of Citation analysis study on scientific research.
- To study the implications of Bibliometrics Law's Impact in different contexts of research.
- To understand the meaning of Impact Factor, Activity index, and other measures.
- To have a consolidated view of impact factors in a country's research productivity.

4.1. STRUCTURE OF UNIT

- Introduction
- Bibliometric criteria for evaluating research productivity
- Impact of Citation Analysis
- Individual Productivity and Impact
- Impact-related authorship phenomena
- The impact of research and ranking of journals
- Institutional Productivity and Impact
- Bibliometrics and Country's analysis of the impact of research

- Impact of H-Index
- Impact of the obsolescence rate of documents in different subjects
- Summary
- References

4.2. INTRODUCTION

The two books authored by de Solla Price, "Science since Babylon" and "Little Science, Big Science" published in 1961 and 1963 respectively made a beginning for the quantitative measure of scientific growth and productivity and their impact. The Quantitative measures of research productivity can be applied to products/techniques developed and to the extent of the organization's informing activities. The impact may be judged by the rate of adoption of products and techniques and by various measures of the quality of the informing activities. The outcomes of the research are really its impact. For many types of research, obviously, the impact is a long-term affair. Research in education may be directed to improving the general education level among a particular group of people. For other types of research, the impact is less tangible – it may simply be better understood. An obvious example is historical research, which seeks to achieve a better understanding of some event or individual from the past. The outputs of the research process are the results achieved. For many types of research, these results are manifested as a new product or technique. Research results have little value in and of themselves. They become valuable only when they are made known to individuals or organizations that can help them. The research group makes its results known by reporting them in various ways: in internal reports, in reports published and distributed in several forms viz. books, journals, monographs etc. If the research cannot be evaluated by its long-term impact of benefit for the society is futile.

4.3. BIBLIOMETRIC CRITERIA FOR EVALUATING RESEARCH PRODUCTIVITY

The extent and type of publication of the research results is the most obvious and immediate impact of a particular research activity. Presumably, the more widely disseminated the results of some project, the greater the impact that project or product is likely to have. But publications themselves have different levels of impact. Some formats are more widely distributed than others; some enjoy a grater reputation; some reach out to wider communities and thus may have more profound effects. Bibliometric criteria for evaluating research productivity include (Lancaster, 1991).

- How many publications are produced;
- How many publications of what types are produced;
- The quality of the sources (e.g., journals) in which the publications appear;
- How much the work of an individual, group or organization is cited;
- What is the quality of the citation (e.g., as judged by the quality of the citing journal);
- How many publications are produced per individual, per man hour expended; and
- How many citations are received per individual, per man hour expended, per $ expended.
- The Bibliometric methods therefore have many possible applications in the management of research, including:
- Evaluation of the productivity of a particular researcher (perhaps for appointment or promotion);
- Evaluation of the impact of the work of an institution or research group;
- Identification of possible new research areas on the basis of interdisciplinary citation linkages;

- Identification of institutional linkages (i.e., which institutions draw most heavily on each other's work); and
- Assisting in the establishment of research policies or priorities in resource allocation.

4.4. IMPACT OF CITATION ANALYSIS

The primary function of a citation is to provide a connection between documents - one which cites and the other which is cited. Citation is the best available indicator of the use of a document. The first use of Shepherd's citations was published in 1873. This technique of 'Citation' has been perfected by Eugene Garfield and others since the early 1960s (Garfield, 1963)**.** It is a fact that the compilation of bibliographies in new fields is really difficult. In such circumstances, analysis of citations of articles may be one of the ways to gather information on a particular subject field. The very fact that the citations have been verified, evaluated, and recommended by authors who are experts in their own fields makes them all the more acceptable for inclusion in a bibliography. Citations given may be of books, journal articles, reports, standards, theses/dissertations, etc. the relative use of each of these types can be ascertained based on the frequency of citations. For example, various citation studies have shown that journal articles are the most preferred source consulted by scientists since they constitute about 70-80% of the total citations. Similarly, citation practice among social scientists indicates that they give equal importance to books and journals.

4.5. INDIVIDUAL PRODUCTIVITY AND IMPACT

However, purely quantitative measures are inadequate indicators of research output. The type of publication and the reputation of the publisher should also be taken into account. Various attempts have been made to assign some type of numerical score to the output of a researcher based on what is published and where, and this is how the individual productivity and impact is measured. Narin deals with this topic, and more recent scoring methods have been presented by him (Narin, 1976). In general, such scoring methods take into account some or all of the following factors:

- The type of publication;
- The size of the publication;
- The reputation of the publisher; and
- The amount of work going into creating publications of various types.

The different fields of the scholarship will adopt different standards for scoring research output. The research monograph in the humanities, which may represent many years of work, will probably earn more credit (relative to other forms of publication) than would be true for a research monograph in the sciences. In some fields, monographic publications may be considered less important than journal articles, and even other forms, and may receive less credit accordingly. This factor is well demonstrated by Sabarathnam who tried to achieve some consensus among a panel of experts, on the scoring of publications in the field of agricultural research. The Panel members the author remarks ranked seven possible publication forms. Among the first, the Research papers received the highest score (6.32 on the 7-point scale), then books scored 5.38, and finally popular articles 4.16 and review articles 4.06 (Sabarthnam, 1987).

4.6. IMPACT RELATED AUTHORSHIP PHENOMENA

It is now widely recognized that scholarly productivity, as measured by the number of publications produced, is an elitist phenomenon: most authors contributing to a particular body of literature contribute very little and the number of authors who are highly productive is very small indeed. Following the original work of Lotka (Lotka, 1926), this phenomenon is now popularly referred to as Lotka's Law. It is an inverse square law: if X authors contribute one paper each to a field, the number contributing two papers should be approximately X/2, the number producing three papers should be X/3, and so on. Lotka found that about 60% of the authors contributing papers to a field contribute only one paper, so the percentage contributing two would be 60/2, about 15%, the percentage contributing three papers would be 60/3, or below 7%, and so on, so the highly productive authors form a very small proportion of the total. In the latest studies, Lotka's law is not applicable due to changes in research patterns.

Gupta and Sangam (2009) studied the top 20 most productive authors of Karnatak University who together have contributed papers during 1999-2008, accounting for 81.87% of the total university output (Gupta & Sangam, 2009), average output per author was 49.9. Further, only four out of 20 authors have published more than the average output per author. These authors are Tejraj M Aminabhavi (260 papers), followed by Sharanappa Totappa Nandibewoor (133 papers), Jaldappa Seetharamappa (56 papers), and Hosakatte Niranjana Murthy (50 papers). Similarly, the average citation per paper recorded by all 20 authors of the university was 3.78. Only five out of 20 authors have recorded the average citation per paper more than the average value. These are Kumaresh S Soppimath with the average citation per paper value of 12.47, followed by Anandrao R Kulkarni (7.70), Mrityunjaya Aralaguppi (6.73), Mahadevappa Y Kariduraganavar (5.63), Tejraj M Aminabhavi (5.59) and Jaldappa Seetharamappa (3.82). The average h-index of these 20 authors during 1999-08 was 5.85. Only four authors have scored the h-index value more than the average value of all authors. These authors are Hosakatte Niranjana Murthy with h-index value of 41, followed by Tejraj M Aminabhavi (28), Kumaresh S Soppimath (7), and Anandrao R Kulkarni (6) (Table 1). It is found in this study there are a greater number of multi authored papers than single authored papers, this is due to the impact of trend in collaboration.

Table 1: Productivity and Impact of Top 20 Authors, 1999-2008

Authors Name	TP	TC	h-index	ICP
	99-08	99-08	99-08	99-08
Tejraj M Aminabhavi	260	1454	26	28
Sharanappa Totappa Nandibewoor	133	266	11	1
Jaldappa Seetharamappa	56	214	11	3
Hosakatte Niranjana Murthy	50	125	10	41
Kalagouda B. Gudasi	45	48	7	2
Guru S Gadaginamath	40	63	6	4
Srinivas K Saidapur	39	76	8	4
Kulkarni, Anandrao R	40	308	2	6
Shivamurti A Chimatadar	35	58	6	0
Manohar V Kulkarni	38	40	5	3
Mahadevappa Y Kariduraganavar	35	197	10	2
Bhagyashri A Shanbhag	34	58	7	3
Kumaresh S Soppimath	32	399	17	7
B. Mulimani	31	34	5	4
Basappa Basavanneppa Kaliwal	28	47	6	0
Ramesh S Vadavi	27	64	1	2
Sangamesh Amarappa Patil	26	91	7	2
Ravindra B Malabadi	25	45	6	5
Kallappa Mahadevappa Hosamani	24	36	5	0
Mrityunjaya Aralaguppi	22	148	1	0
Total	1020	3771	3.79	5.85

TP – Total Papers TC- Total Citations
ICP – International Collaborative Papers

4.7. THE IMPACT OF RESEARCH AND RANKING OF JOURNALS

Journals are an important vehicle for scholarly communication. Garg & Rao[9] observed that Impact Factors are widely used to rank and evaluate journals (Garg & Rao, 1988). They are also often used inappropriately as surrogates in evaluation exercises. The impact factor for ranking journals was first used for the inclusion of journals in the Science Citation Index (SCI) and the originator of SCI warns against the indiscriminate use of these data. Lancaster has given some possible criteria for the evaluation of scholarly journals as below (Lancaster, 1991):

- Size – Includes No. of papers, no. of pages, and no. of words
- Circulation (Sales)
- Impact – Citation, Citation per paper, Immediacy, and Influence
- Age of sources cited
- Exclusiveness
- Coverage in Databases (May be in Abstracting and Indexing Services)

The Impact Factor is generally calculated on the basis of a 2-year period. For example, the 2007 Impact factor for a journal would be calculated as follows:

A = Number of times articles published in 2005-06 were cited in tracked journals
during 2007
B = Number of articles published in 2005-06
Impact Factor (2007) = A/B

There are some nuances to this: Institute for Scientific Information (ISI) excludes certain article types (such as news items, correspondence, and errata) from the denominator. New journals, which are indexed from their first published issue, will receive an Impact Factor after the completion of two years' indexing; in this case, the citations to the year prior to Volume 1, and the number of articles published in the year prior to Volume 1 are known as zero values. Journals that are indexed starting with a volume other than the first volume will not have an Impact Factor published until three complete data years are known.

Annuals and other irregular publications will sometimes publish no items in a particular year, affecting the count. The impact factor relates to a specific time period; it is possible to calculate it
for any desired period and the Journal Citation Report (JCR) also includes a 5-year impact factor. It is regarded by many editors and editorial management committees as a measure of the “importance” of particular journals, and to some extent this is true: journals such as Nature, Science, and New England Journal of Medicine have a high impact factor The impact factor, often
abbreviated as IF, is a measure reflecting the average number of citations to articles published in science and social science journals.

For example, the same journal i.e. New England Journal of Medicine published 366 "citable" articles in 2003 and 378 "citable" articles in 2002. Citations in 2004 to any articles published in 2003 and 2002 are 14147 and 14549, respectively. The following formula was used to calculate, the (IF) for this journal in 2004:

IF = 14147+14549 = 38.6 in 2004
366 +378

4.8. INSTITUTIONAL PRODUCTIVITY AND IMPACT

The research output of an institution, or of a single group or a team within an institution, can be considered as the sum of the output of the individual members, so the various factors discussed in relation to individual productivity and impact are also relevant to institutional productivity and impact. Nevertheless, the evaluation of an institution does present additional problems that merit
special consideration. Garg and Rao (Garg & Rao, 1988), in evaluating an Indian physics laboratory, recognize four categories of journals:

- Indian journals covered by the Science Citation Index,
- Non-Indian journals covered by the SCI,
- Indian journals not covered by the SCI, and
- Non-Indian journals are not covered by the SCI.

The implication is that, on average, an SCI-covered journal is likely to be better, on average, than Indian ones. At the very least, one can assume that the international journals will give the Indian researcher greater exposure than the national journals, especially those international journals covered by the SCI.

It is a common understanding that the science journals covered by the Science Citation Index are usually considered to be the mainstream journals of science research (and likewise, presumably, for the Social Science Citation Index) and the journals not covered are regarded as of less importance. The criterion coverage in the SCI, then, can be used to divide into two categories - the journals in which the researchers of a particular institution have published. Presumably one would give more weight to publication in an SCI-covered journal.

But one would probably prefer a weighting scheme that has more than two values. It is obviously possible to use one that incorporates some form of numerical value for the journals in which papers appear. Thus, the impact of the work of a group might be represented by a numerical value that takes into account how many papers they have published in journals.

Again taken from the study of the faculty of Karnatak University who had published their total research output in 238 Indian and foreign journals during 1999-2008, the contribution of the top 20 most productive journals is listed in Table-2. The cumulative output of these top 20 journals consists of 179 papers during 1999-2003, 301 papers during 2004-2008 and 480 papers during 1999-2008, accounting for 38.66%, 39.81% and 39.38% of the total output of Karnatak University.

Table 2: Contribution of Karnataka University faculty in top 20 journals during 1999-2008

S.No.	Journal	Total Papers		
		1999-03	2004-08	1999-08
1	Journal of Applied Polymer Science	28	60	88
2	Transition Metal Chemistry	16	26	42
3	Polymer News	23	13	36
4	Indian Journal of Chemistry Section B. Organic & Medicinal Chemistry	15	18	33
5	Indian Journal of Chemistry Section A. Inorganic Physical Theoretical & Analytical Chemistry	17	12	29
6	Journal of Basic and Clinical Physiology and Pharmacology	10	13	23
7	Act a Crystallographic a Section E Structure Reports Online	7	15	22
8	Oxidation Communications	12	10	22
9	Journal of the Indian Chemical Society	9	13	22
10	Journal of Membrane Science	0	21	21
11	Spectrochimic a Act a Part A Molecular & Biomolecular Spectroscopy	5	16	21
12	Indian Journal of Heterocyclic Chemistry	2	18	20
13	Journal of Chemical and Engineering Data	5	14	19
14	Current Science	10	8	18
15	Carbohydrate Polymers	0	11	11
16	Separation and Purification Technology	0	11	11
17	Ecology Environment and Conservation	5	6	11
18	Journal of Advanced Zoology	5	6	11
19	Analytical Sciences	9	1	10
20	Indian Journal of Experimental Biology	1	9	10
	Total	**179**	**301**	**480**
	Karnatak University Output	463	756	1219
	Share of Top 20 journals in Karnatak University Output	38.66	39.81	39.38

productivity of the University may be assessed. However, the impact factor of these journals is considered first as per the criteria enlisted by Lancaster and the mode of calculation of IF by SCI. But the study is confined to the Chemistry subject field, and it may vary with the subject field because researchers in chemistry are more prolific than others even in sciences.

4.9. BIBLIOMETRICS AND COUNTRY'S ANALYSIS OF IMPACT OF RESEARCH

In the previous sections, it has been seen how bibliometric data can be used in the assessment of productivity and the impact of research by individuals and then institutions. This section discusses how bibliometric data can be used for country analysis and to make the comparison of the productivity and impact of research by various countries and regions. Lancaster has stated that "when countries are ranked by the productivity of scientific papers, most advanced countries will be at the top of the list; however, India ranks as the most productive among the developing countries.

Garfield prefers to use a form of impact factor in comparing the relative influence of papers produced by scientists from various countries. For example, in his analyses of Latin American research, he shows that Chilean papers have the highest impact: the 312 papers published by Chilean scientists in 1978 earned 1017 citations in 1978-1982, for an average impact of 3.3, whereas papers from Peru achieved an impact of only 1.5. In contrast, he points out, that Scandinavian papers achieve an impact of 6.4 and US papers have an impact of 5.7. This is just to exemplify how the impact of research can be assessed.

Narin has described a cross-country citation measure that compares the actual citations received by papers from a particular country to the expected number of citations. The expected number of citations is based on the proportion of the world's papers that are contributed by that country. To illustrate this in a probabilistic manner, if country X publishes 2% of the world's scientific papers, it should receive 2% of the world's science citations. If it receives more, it is cited more than expected. This can be illustrated by looking at the relationships between two countries. For simplicity, let us assume two countries, A and B. Country A publishes 90 papers in a year and country B publishes 10 papers. Since A publishes 90% of the world's papers (in this simple model); it should receive 90% of its own citations and 90% of the citations from B. That is, in a probabilistic sense, the equation should equal 1. Let us examine this by computing the data for A and B.

$$\frac{\text{Number of references from B to A / Number of references from B}}{\text{Number of A publications (90) / Total number of publications (100)}}$$

This would be true if the papers published by B contained 150 bibliographic references, 135 of
which were to A's papers;

$$\frac{135/150}{90/100} = \frac{0.9}{0.9} = 1.0$$

Suppose, on the other hand, that 140 of B's references are to A's papers,

$$\frac{140/150}{90/100} = \frac{0.93}{0.9} = 1.03$$

So, A is cited probably more than B as suggested above. In this type of analysis, a value in excess of 1 indicates that a country is cited more than expected, and a value below 1 that is cited less than expected. Narin has presented tables to show how various countries cite each other in different subject fields and how various countries cite themselves (Narin 1976).

One of the examples of the comparison of countries can be shown in a paper published by Sangam (Sangam, 2005). He has presented the Demography of Publication output and world share of publications of major countries as indicated in Table 3. The top 5 countries viz., USA, India, Canada, France, and China account for about 30.89% of the world output in 1987-1989 and 31.59% of the world output in 1997-1999. The United States alone account for 15.99% of the world's output in 1987-1989 and 17.51% in 1997-1999. South Africa accounts for smallest output 0.67% in 1987-1989 and 0.62% in 1997-1999. The share of the major countries has increased over the ten-year period from 51.09%. The increase in the share of the major countries is essentially due to the increase in the share of the USA, Australia and China. India's world share has decreased from 5.14% in 1987-1989 to 4.67% in 1997-1999. There is a decline in the world share of Brazil, Canada, Egypt and England. The data is presented in Table – 3 below.

Table 3: Publication output and World share of major countries

Country	Number of Publications		World Share (%)	
	1987-1989	1997 -1999	1987-1989	1997 –1999
Australia	140	214	1.44	2.07
Bangladesh	138	167	1.42	1.62
Belgium	90	76	0.92	0.74
Brazil	134	111	1.37	1.07
Canada	342	294	3.51	2.85
China	297	351	3.05	3.40
Egypt	114	80	1.17	0.77
England	169	150	1.73	1.45
France	312	327	3.20	3.16
India	501	483	5.14	4.67
Indonesia	147	74	1.51	0.72
Italy	149	201	1.53	1.95
Japan	191	167	1.96	1.62
Mexico	142	231	1.46	2.24
Netherlands	196	216	2.01	2.09
Pakistan	69	63	0.71	0.61
Poland	131	84	1.34	0.81
South Africa	65	64	0.67	0.62
Spain	95	150	0.97	1.45
United States	1560	1809	15.99	17.51
Total	4,982	5,312	51.09	51.41

4.10. IMPACT OF H-INDEX

The h-index (known as the Hirsch index) is “an index that qualifies both the actual scientific productivity and the apparent scientific impact of a scientist” e.g. an h-index of 20 means the researcher has 20 papers each of which has been cited 20+ times. (Whitton, 2013). The index is based on the set of the scientist’s most cited papers and the number of citations that they have received in other people’s publications. H-index eliminates the disadvantage of considering only single number criteria such as the total number of papers or numbers of significant papers etc. The h-index is proportional to the academic age of the research. For e.g.: If a scientist has written 50 papers. 30 of which have achieved 30 or more citations, his or her h-index is 30. Therefore, the h-index of an individual scientist is defined as the number of his/her publication cited more than h times in scientific literature.

4.11. IMPACT OF THE OBSOLESCENCE RATE OF DOCUMENTS IN DIFFERENT SUBJECTS

Citations in subsequent literature and usage pattern in libraries are considered as two indicators of the obsolescence of literature. Analysis of citations by age of the cited document can show the useful life of a document. In order to measure the decay or obsolescence rate of documents, the concept of ‘half-life’ has been borrowed from Nuclear Physics. Using this measure Burton and Kebler had suggested a range of half-lives for different subjects. The fast-growing subject would have lesser half-lives compared to established disciplines. The above study had shown the half-life of Metallurgical Engineering as 3.9 while that of Botany is 10 years. These time scales are highly useful in the planning of library holdings.

4.12. SUMMARY

The use of Bibliometrics methods and especially bibliometric laws have been made since; the advent of the field and has attracted the interest not only of LIS professionals but also a quite good measure by pure scientists as well. The best example is the prolific writings of Prof. P. Balaram in his editorials to Current Science. It is a common established feeling that bibliometric techniques can be used to assess and evaluate scientific research and products and productivity. However, caution must be observed that they are only empirical studies based on Quantitative data and cannot intrinsically evaluate the quality and application of research. Now, bibliometrics is gradually giving way to its incarnated fields like Informetrics and Scientometrics which are more on the study of indicators and collaboration and public policy – precisely the study of science. However, the longtime research output in these areas cannot be ignored and has some indications of their fruitful and more rational applications in the assessment and evaluation of productivity and the impact of research. In this context, it is important to observe not only the quantitative data of scientific output but also the social, economic and educational, and even political conditions of countries when assessing them and not just taking them for granted on the basis of quantitative data on research productivity and its impact on various awards and qualifications.

Now the time has come for Bibliometricians, Informetricians, and Scientometricians to come together and engage in a fruitful exchange of ideas with the objective of promoting research culture in the areas of quantitative studies in Library and Information Science, including the quantitative studies of science in general and particularly of science policy, science programs, and science administration and the socio-economic and educational culture of the nations. It is all the more important to give serious thought to practising them in a day–to–day activities in relation to their impact on research. Econometrics, Psychometrics, and Sociometrics are well-defined disciplines and key subjects because of their practical applications and their usefulness to society, hence evaluative bibliometrics too has to play a vital role in assessing productivity and impact on research.

4.13. MCQ QUESTIONS

1. Shepherd's citations published in: A. 1873 B. 1973 C. 1773 D. 1673

2. The inventor of the Science Citation Index: A. D .S Price B. E. Garfield C. Lancaster, F.W D. Goffman, William

3. The Institutional Productivity: A. The research output of an institution B. Material Production of an institution C. Group of Employees production D. Identification of institutional linkages

4. The inventor of h-index is: A. Ranganathan B. Lucy Tedd C. H.Hildrun D. Hirsch

5. Journal Citation Report (JCR) gives: A. Ranking of Journal B. Impact Factor of Journals C. Impact Factor of Books D. Impact Factor of the Library

6. The Impact Factor of a Journal is generally calculated on the basis of a ______ year period A. 1 B. 2 C. 3 D. 4

7. A cross-country citation measure that compares the actual citations received by _______ from a particular country. A. Citations received from one country to another Country B. Citations received between two countries C. A bibliographic Coupling D. Actual citations received by papers from a particular country to the expected number of citations

8. The h-index measures the scientific productivity of the individual scientist. True/False

9. The obsolescence rate of documents indicates the total life of a document from its publication. True/False

10. h-index has a positive bias towards senior researchers. True/False

11. Giving reference to one's own previous works _________

12. A measure reflecting the average number of citations to recent articles published in the journal and intended to gauge the importance of a journal in its given field __________

13. An indicator which measures the current importance of the work published by a journal by calculating the average number of times articles published during a particular year by a specific journal are cited over the course of that same year __________

14. Crown indicator ________

15. Scopus is ______

16. Publication counts ________

17. ____________ bibliography lists publications produced in a country.

18. Full-text Sources Online (FSO) is a: A. Database of primary publications B. Full text online encyclopedia C. Directory of periodicals accessible online in full-text D. Abstracting journal

19. What is the product of Elsevier Inc? A. Business Source Premier B. Emerald Management Xtra C. Scopus D. All of the above

20. Cited Reference Search produces which kind of list? A. Articles B. Papers C. Journals D. All of the above

4.14. SHORT QUESTIONS

What are the disadvantages of the h-index?

What is the importance of citation analysis?

4.15. LONG QUESTIONS

What are the impacts of the obsolescence rate of documents in different subjects?

What is the h-index and impact factor?

Trace the evolution and development of bibliometrics and enumerate its scope and applications in libraries.

KEYWORDS: h-index; Citation analysis; Obsolescence rate

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UNIT 5

DIFFERENT MODELS TO EXPLAIN THE PHENOMENA OF GROWTH AND OBSOLESCENCE OF LITERATURE

5.0. OBJECTIVES

- Different models are useful to explain the data on the growth of literature--exponential, logistic, power, Gompertz, etc.
- Obsolescence of literature
- Relation between the growth of sources and items, growth rates and obsolescence rates, etc.

5.1. OUTCOME OF LEARNING

It is an important concept and you have now learned it. At the end of this module, you have also learned various growth models and their characteristics; also, the relations among the various models; how to identify the trend, and how to compute growth rates, doubling time, etc.

5.2. STRUCTURE OF UNIT

- Introduction
- Different Models of Growth
- Selecting a Trade Type
- Obsolescence of Literature
- Summary
- References

5.3. INTRODUCTION

The numbers of scientific journals including the abstracting periodicals are simple indicators of scientific growth. Price in 1963 argued observed that literature doubles approximately once in fifteen years. Neelameghan (1963) analyzed the documents on the history of medicine in India for the period 1954-61, during which period Indian contribution was 65% and foreign was 30%. He studied the growth of Indian medical societies and medical periodicals between 1780 and 1920. He also studied the coverage of Indian medical literature in Index Medicus and Experta Medica and it was found that they covered respectively only 38% and 13.5% of the Indian literature. Since then, a number of articles were published on this topic, particularly the growth of literature on different subjects and on various growth models. The number and the growth characteristics (of articles, journals, scientists, discoveries, etc.) have been matters of some debate for a considerable time. For instance, Price (1963) argued that:

- Once in fifty years the number of universities, labor force, population, etc. doubles;
- Once in twenty years GNP, discoveries, scientists, college entrants/1000 population doubles;
- Once in fifteen years the number of scientific journals doubles;
- Once in ten years the amount of articles/literature in a field (particularly in science) double; and
- Once in two years the number of web sites doubles

As observed by many, the growth of publications passes through the following four stages (Price (1963), Michael Mabe (2003) and many others):

- The preliminary period of growth in which the absolute increments are small although the rate of increase is large – this is the first stage;
- During the period of exponential growth, the number of publications in a field doubles at regular intervals as a result of a high rate of growth – this is the stage 2;

- The rate of growth declines but the annual increments still remain approximately constant, in stages 3; and
- In the fourth stage, both the rate of increment and the absolute increase decline and eventually approach to zero.

The growth curves which explain the above four steps are also referred to as S-shape curve. A typical S-shape curve is given in Figure 1. This Figure clearly shows the four different stages – in X – axis, 0 to 3 is the first stage; 3 to 5 is the second stage; 5 to 7 is the third stage and 7 to 8 is the fourth stage. The growth generally adopts an S-shaped pattern and is symmetrical about its point of infection. Price in 1963 estimated that the number of scholarly periodical titles being published at the end of the twentieth century would exceed one million. This however has not come true.

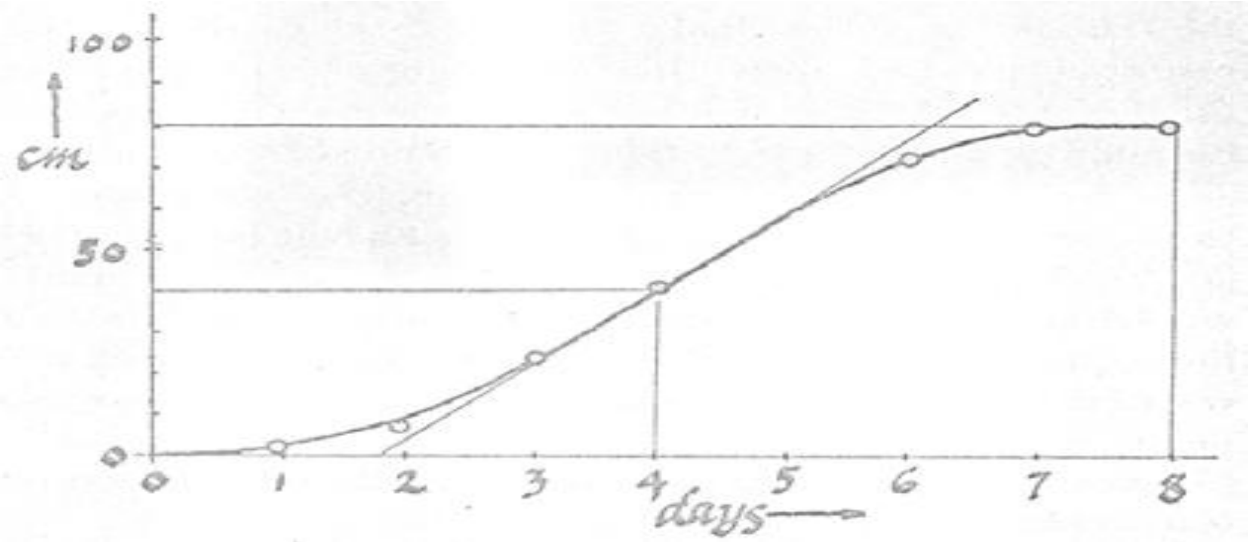

Fig. 1: A Typical S-shape Curve

He argued that the logistic growth of knowledge over a period of time as a result of a number of applications of intellectual innovations. A logistic curve was fitted to the cumulative number of new publications appearing every year in science. He has also studied the growth of literature covered by Physics Abstracts during 1900-1950. He observed that except for the interruptions during the two world wars the literature has been increasing at exponential rates with a doubling time of about twelve years. Meadows (1993, 1998) on the other hand observed that estimates of the number of journals varied from 10,000 in 1951 to 70,000 in 1987. Mabe (2003) in his study also observed that journal growth rates have been remarkably consistent over time with average rates of 3.46%, since 1800. He has in fact observed:

- From 1900 to 1940, the number of active journal titles grew at an actual rate of 3.23%, a doubling time of twenty-two years.
- From 1945 to 1976, the number of journals grew at an annual rate of 4.35%, representing a doubling time of sixteen years.
- Since 1977, the number of journals grew by 3.26%. Growth rates were very high; this trend continued until the mid-1970s. It May be pointed out that the slow growth rates after the mid-1970s were due to
- The oil crisis of the 1970s
- The increasing public awareness of potential ecological disasters and
- The turning away from nuclear technology in the 1950s.

These factors, certainly lead to a slow down of government support for research. Yamazaki (1998), with the following three assumptions

i. The number of journals on a given subject is growing exponentially over time,
ii. Concurrently each journal is also augmenting the number of papers on the subject exponentially in time, and
iii. The rate of growth of articles in the individual journal is the same for all journals, Studied the number and rate of growth of scientific journals. His review critically assesses studies based on the 'ecological approach' to journal publishing growth. He concluded that the annual rate of growth of scientific journals is 1.85% from the end of the eighteenth century. Naranan (1970) has shown that 'a frequency distribution (J(p)) of the number of journals with p articles is of the form

$$J\,(p) \propto p$$

5.4. DIFFERENT MODELS OF GROWTH

5.4.1. The Exponential Model

An exponential model is associated with the name of Thomas Robert Malthus (1766- 1834) who first realized that any species could potentially increase in numbers according to a geometric series. Exponential growth represents an increase with a fixed proportion of the total population for each unit of time. For example, if a species has non-overlapping populations (e.g., annual plants), and each organism produces "b" offspring, then, the initial size of the population, say "a", in time t=0,1,2, is equal to (12):

$$Y_t = a.b_t$$

In this case, the growth rate is (b-1) * 100. This model is also popularly known as an exponential model or log-linear model, and is often expressed as:

$$\ln y = \ln \alpha + \beta\, x,$$

Here β is the slope of the curve and measures proportional changes in y for a given absolute change in x. The model not only provides the rate of growth (the exponential parameter), but also the rate at which the size of the population doubles. The exponential growth has also been linked and compared with the size of compound interest. The exponential function assumes a convex shape in its graphical presentation. In exponential growth, the increase is proportional to population size,
i.e. if the population is y at time t then

$$\frac{1}{y}.\frac{dy}{dx} = \beta$$

where β is the Malthusian parameter of the population. In terms of differential equations, if Y is the population, and dy/dx its growth rate, then its relative growth rate is $\frac{1}{y}.\frac{dy}{dx} = \beta$ If the relative growth rate is constant, it is not difficult to verify that the solution to this equation is P(x) = exp(βx). When calculating or discussing relative growth rate, it is important to pay attention to the units of time being considered.

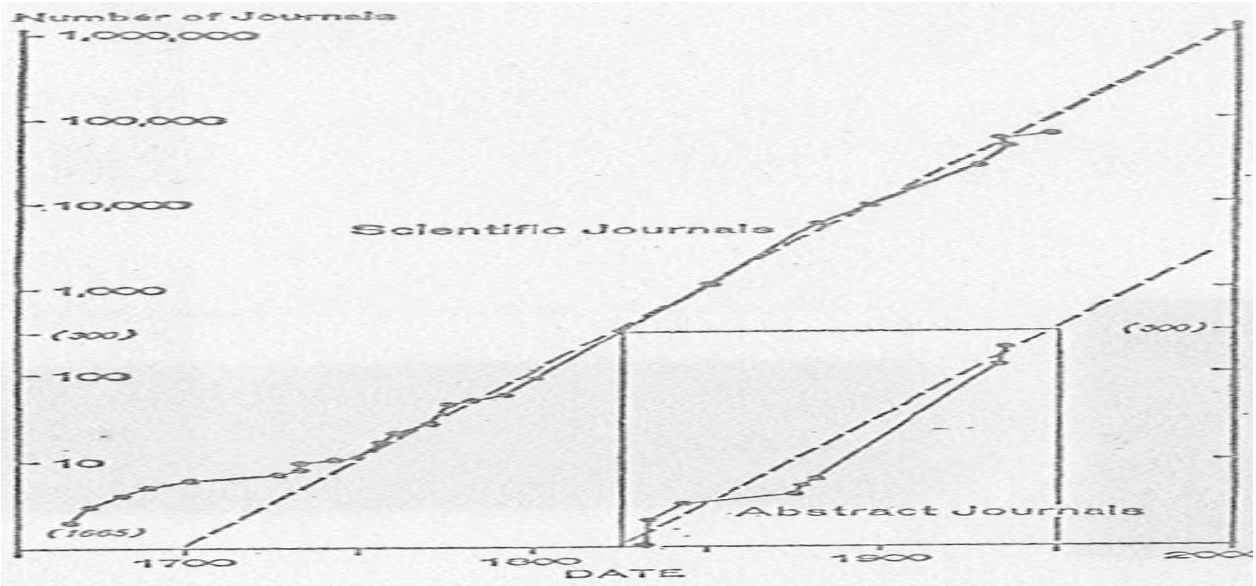

Fig. 2: Total # of scientific journals and abstract journals, as a function of date (Source: Little Science Big Science)

If the growth rate is relative to the size of the population, then it is generally referred to as the relative growth rate. It is also called the exponential growth rate, or the continuous growth rate. The exponential function can be applied to both the growth process as well as decay process (obsolescence studies). The examples of the growth process are given below (Croxton and Cowden (1966)):

- Growth of literature – growth of articles, journals, author population, universities, etc.;
- Microbiology (growth of bacteria);
- Conservation biology (restoration of disturbed populations);
- Insect rearing (prediction of yield);
- Plant or insect quarantine (population growth of introduced species); and
- Fisheries (prediction of fish dynamics).

A typical exponential curve is shown below:

The **doubling time** is the period of time required for a quantity to double in size or value. It is applied to population growth, library collection, the number of universities or colleges or students, and many other things which tend to grow over time. When the relative growth rate (not the absolute growth rate) is constant, the quantity undergoes exponential growth and has a constant doubling time or period which can be calculated directly from the growth rate. This time can be calculated by dividing the natural logarithm of 2 by the exponent of growth, or approximated by dividing 70 by the percentage growth rate; that is:

$$D_t = \frac{\ln 2}{\ln(1 + \frac{r}{100})} \simeq \frac{70}{r}$$

The doubling time helps us to understand the long-term impact of growth than simply viewing the percentage growth rate. The doubling time is a characteristic unit (a natural unit of scale) for the exponential growth equation and its converse for exponential decay is the half life. For example with an annual growth rate of 4.8%, the doubling time is 14.78 years and a doubling time of 10 years corresponds to a growth rate between 7% and 7.5% (actually about 7.18%). Some doubling times calculated with this formula are shown in the following Table:

Table1: Doubling times D_t given constant r% growth

r%	D_t	r%	D_t	r%	D_t	r%	D_t
0.1	693.49	3.0	23.45	6.0	11.90	9.0	8.04
0.5	138.98	3.5	20.15	6.5	11.01	9.5	7.64
1.0	69.66	4.0	17.67	7.0	10.24	10.0	7.27
1.5	46.56	4.5	15.75	7.5	9.58	15.0	4.96
2.0	35.00	5.0	14.21	8.0	9.01	20.0	3.80
2.5	28.07	5.5	12.95	8.5	8.50	20.0	3.80

Given the two measurements of a growing quantity, q_1 at time t_1 and q_2 at time t_2, and assuming a constant growth rate, you can calculate the doubling time as

$$D_t = (t_2 - t_1)x\frac{\ln 2}{\ln\left(\frac{q_2}{q_1}\right)}$$

The equivalent concept to doubling time for a material undergoing a constant negative relative growth rate or exponential decay is the half-life
The Calculation of Simple Percentage Growth rate
The percent change from one period to another is calculated from the formula:

$$GR\,(\%) = \frac{(y_{t+1} - y_t)}{y_t}\ x\ 1$$

Where:
GR(%) = Percent Growth Rate
y_{t+1} = Value at time (t+1)
y_t = Value at time t
The annual percentage growth rate is simply the percent growth divided by N, the number of years.

Example
In 1980, the number of documents in Library A was 250,000. This grew to 280,000 in 1990. What is the annual percentage growth rate of library collection in Library A?
y_t = 250,000, y_t+10 = 280,000 and N = 10
N = 10

=1.2%

$$GR\ (\%) = (\frac{(280000-250000)}{250000}\ x\ 100)$$
$$= 1.2\%$$

The library collection grew 12 percent between 1980 and 1990 or at a rate of 1.2 percent annually

5.4.2. The Logistic Model

The Belgian mathematician Pierre Verhulst (1838) developed the Logistic model (17). A typical logistic curve is shown in Figure 3. He suggested that the rate of population increase might depend on population density:

$$y = \frac{a}{bc^t}$$

behaviors of both exponentials and powers (proportions, like rational functions). The parameters b and c are simply the y-intercept and the base of the component exponential function bc t. The rate at which a logistic function falls from or rises to its limiting value is completely determined by the exponential function in the denominator, by the parameters b and c.

Here, as observed in exponential function, one notice that logistic function depends on the population itself, i.e., $\frac{dy}{dx} = \lambda(1 - \frac{y}{k})y$ Pearl and Reed have independently developed and they used the curve to describe the growth of albino rat and tadpole's tail, the number of yeast cells, and most interesting of all, the number of human beings in a geographical area. The curve is also known as Pearl and Reed curve.

The curve depicts three things, as explained in section 1:
i. Show growth in the early stage.
ii. Intermediate period of rapid growth
iii. An approach to maturity.

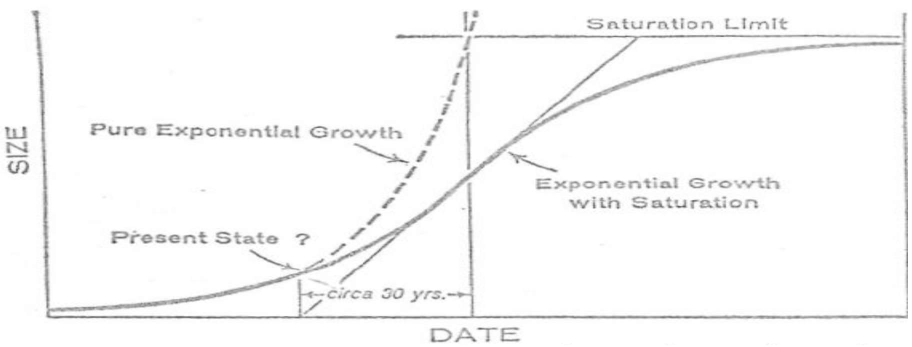

Fig. 3: A typical logistic curve

5.4.3. The Power Function
It is a log-log or double log model. It is mathematically represented as:

$y = \alpha\ t_{\beta}$

i.e., log y = α+ βlog t

Sometimes, the power model is also represented as

$$y_t = \alpha + \beta t_{\gamma}$$

where α, β > 0. For 0 < γ< 1, the function y takes a concave shape, but without an upper limit. For γ = 1, the function y assumes a linear shape. For γ > 1 the function y takes a convex shape. A typical Power model is shown in Fig. 4.

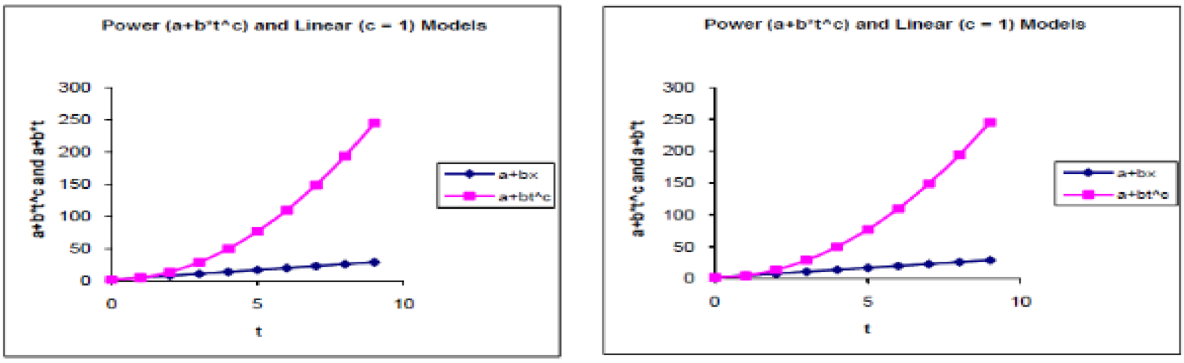

Fig. 4: A Typical Power Model

5.4.4. The Gompertz Model

The Gompertz (1825) model describes a trend in which the growth increment of the logarithms is declining by a constant percentage. Thus, the natural value of trend would show a declining ratio of increment, but the ratio does not decrease by either a constant amount or a constant percentage. The equation for the Gompertz curve is

$$y = ab^{ct}$$

i.e., $\log y = \log a + (\log b)\, c_t$

The Gompertz and logistic curves are similar in that they both can be used to describe an increasing series, which is increasing by a decreasing percentage of growth, or a decreasing series, which is decreasing, by a decreasing percentage of declines. They differ in that the Gompertz curve involves a constant ratio of successive first differences of the log y values, while the logistic curve entails a constant ratio of successive first differences of 1/y values.

5.4.5. Ware's Model

The other equally well-known model is Ware's model. It is represented as

$$y = \delta\,(1-\phi_{-t})\,\delta,\ \phi > 1.$$

The Figure 5 shows a typical Ware's model.

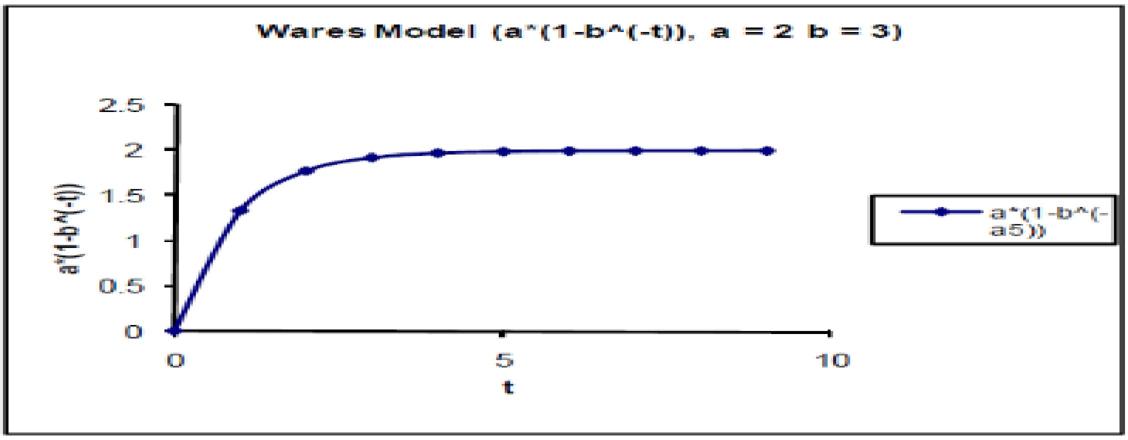

Fig. 5: A Typical Ware's Model

5.5. SELECTING A TRADE TYPE

There are many trend types. It is difficult to decide which one to use. Following are the simple guidelines to select the appropriate model (Croxton and Cowden):

- If the approximate trend, when plotted on semi-logarithmic paper is strait line or if the first differences of logarithms are constant, use an exponential model.
- If the first differences resemble a skewed frequency curve, or if the first differences of logarithms are changing by a constant percentage, use a Gompertz model.
- If the first difference resembles a normal frequency curve or if the first differences of reciprocals are changing by a constant percentage, use logistic model. Also, it the approximate trend value (or the original data), when expressed, as percentage of a selected asymptote, appears linear on arithmetic probability paper, use a logistic model.

Egghe and Rao (1992) have suggested an innovative methodology for identification and classification of growth models. They have classified the growth models based on growth functions, i.e. α_1 and α_2. They have denoted the growth function as C(t) (theoretical or concrete data). These growth rate functions may be defines as:

$\alpha_1(t) = C(t+1)/C(t)$ and $\alpha_2(t) = C(2t)/C(t)$

$t = 1,2,3, \ldots$

α_1 is called the first growth rate function and α_2 is called the second growth rate function. The basic idea here is that the graph of α_1 and α_2 are much more different than the corresponding graphs of other growth models. The theoretical relationship between α_1 and α_2 has been worked out to be:

$\alpha_2(t) = \alpha_1(2t-1)\,\alpha_1(2t-2) \ldots \alpha_1(t)$

According to them, the method of determining the growth goes back to the intrinsic growth rate properties of the data for a good understanding of what is really going on. The authors have also suggested that in order to get a simple clue for the selection of the best model, the plot of two growth rate functions for different mathematical models (namely; exponential, power, linear, logistic and Gompertz) may be drawn and visualized. These graphs can be classified as: Type 1 – increasing, Type 2 – Constant, type 3 – decreasing, Type 4 – increasing and then decreasing, as shown in Table 2.

Table 2: Classification of growth models using growth rate function

Types of model	Growth rate function	
	α_1	α_2
(1)	(2)	(3)
Exponential	Type 2	Type 1
Logistic or Gompertz (0<b, c<1)	Type 3	Type 4
Gompertz (b, c>1)	Type 1	Type 1
Power (α >0, 0< $\gamma \leq 1$)	Type 3	Type 1
Power (α >0, γ >1)	Type 4	Type 1
Power (α > 0)	Type 3	Type 2

Wolfram et.al (1990) explored the Linear, Exponential, and Power model for the growth of publications over a period of 20 years, as reflected in the databases belonging to science, technology, social science, and humanities. They found that, in most cases, the mathematical model that provided the best fit to the observed data was a power model, rather than an exponential, logistic, or a linear model; and they concluded, "The breakdown in exponential growth is well underway. The power model was in particular best because it has the advantages of modeling the growth behavior of both the linear and exponential models.

Egghe and Rao (1992) clarified the formal distinctions between the four models that Wolfram et al. examined, pointing out that any linear model should more properly be recognized as a powerful model of a special kind, and introducing two other comparable models, the Gompertz and Ware functions, that Wolfram et al. did not consider. Revisiting the data collected in the earlier study, Egghe and Rao observed that an exponential model was never the best fit. Indeed, they have shown that such a model could never have been expected to provide the best fit, given that the rate of growth in every database declined steadily over the years studied. They also found that a power model fitted best in cases of convex growth and that a Gompertz model generally fitted best in cases of S-shaped growth. Egghe and Rao's findings suggested that, in modeling the growth of literature, the choice between an exponential and a logistic function may have always been a false one, and that we should instead be asking whether growth is best described by a power-law or a Gompertz function.

5.5.1. Relationship between Growth of Sources (Journals) and Items (Articles)

Egghe (2005) observed that growth rates of sources (journals) usually are different from growth rates of items (articles); further, he argued, "The references in publications grow with a rate that is different (usually higher) from the growth rate of the publications themselves." His study showed that Naranan's model (exponential model: y=act) hardly fits the empirical data. He showed that the "simple" 2- dimensional informetrics models of source-item relations are not able to explain this. He has further shown that a linear 3-dimensional informetrics (i.e. adding a new source set) is capable to model disproportionate growth. The explanation consists of "defining" a set of "super sources" which produce the original sources but which also attach the items into the original sources. In this way, disproportionate growth of references versus articles can be explained by looking at authors. In the same way, the disproportionate growth of articles versus journals (a new dataset is compiled from the database Econlit) can be explained by considering journal publishers. Formulae of such different growth rates are presented using Lotkaian informetrics and new and existing data sets are presented and interpreted in terms of the used linear 3- dimensional model.

Sahoo (2006) in his thesis compared the growth of the journals with that of the articles, in the area of software studies. He observed that the correlation coefficient (r) between the number of journals and the articles is 0.9811. That is, 96% of the variation in y (articles) is due to the variation in x (journals) – the **higher the number of journals, the higher the number of articles**. However, in the case of World literature, he has observed that the correlation coefficient between a number of journals and the number of articles published is only 0.8517. Unlike India, the correlation is not so high for world literature. Figures 6 and 7 show the growth rate curves for journals and articles published by the journals for Indian and World literature respectively from 1990 to 2003. It has been observed that the growth rates of journals have decreased with the decrease of the growth rate of articles. However, for the 'India data for the years 1995 and 2001, it has been observed that when there is negative growth in journals, it does not show any negative growth for the article. From these observations, Sahoo concluded that only in some cases does the growth of journals affect the growth of the number of articles. The growth rate of journals and articles is not the same; for the Indian literature average growth rate is 9% for both journals and the articles and for the world literature the average growth rate of journals is 3% and the average growth rate of articles is 9%. In another study, Ravichandra Rao and Divya (2010) studied the growth of literature in Malaria Research. They also studied the relationship between journals, articles, and authors. Their study suggests that the number of journals, articles, and authors increases approximately exponentially. The number of articles has increased from 3,996 to 57, 627 from 55-65 to 96-05. Also, the number of journals has increased from 503 to 3,072 from 55-65 to 96-05. The R_2 value for the trend for journals, articles, and authors are 0.9502, 0.9475 and 0.9651 respectively; the low R_2 value are perhaps due to the less number of data sets; the Figures 8-10 are much more convincing that the data on journals, articles, and authors increase exponentially. Under the assumption that the data confirm to exponential model, the growth rates have been computed; the growth rates of the journals, articles and authors are 5.31%, 7.38%, and 10.06% respectively. The most important observation is that the number of least productive journal has been increased to 2,951 from 463. This perhaps due to

- Interdisciplinary nature of research in Malaria and related topics
- May be an incomplete bibliography
- High growth rates (exponential in nature!) of journals and articles

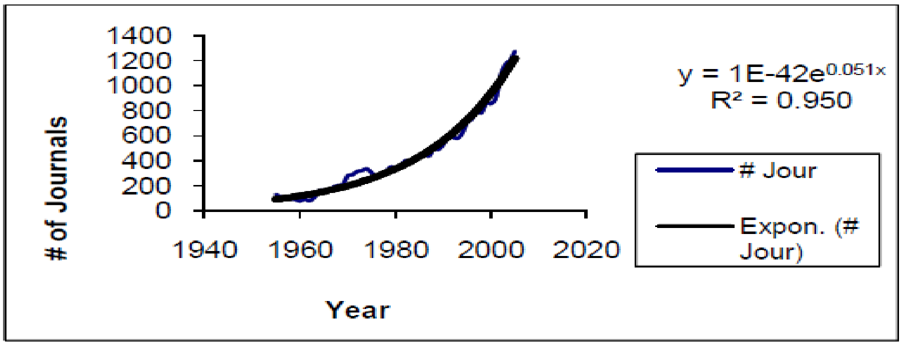

Fig. 8: Growth curve of journals

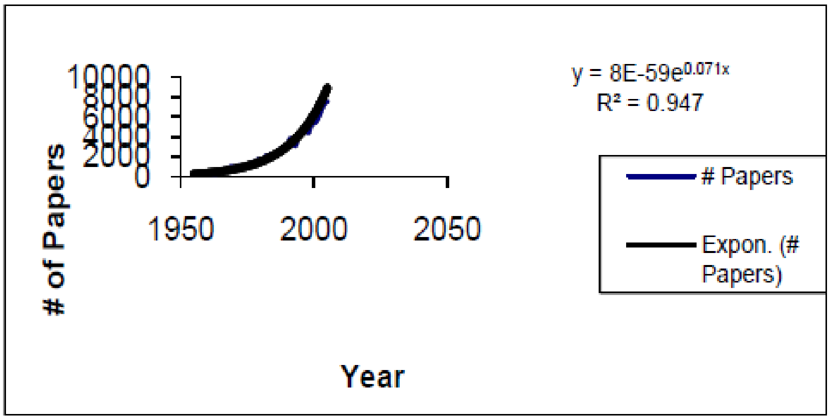

Fig. 9: Growth curve of articles

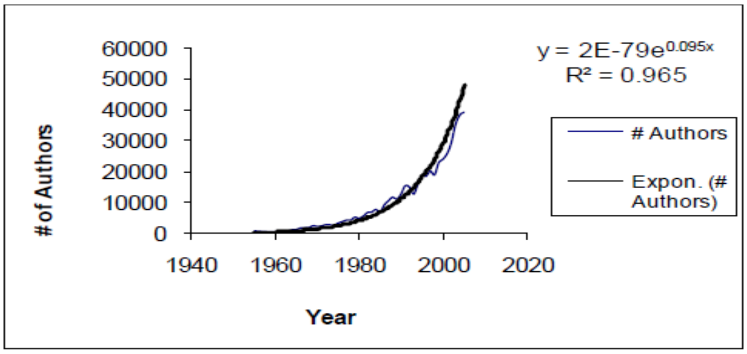

Fig. 10: Distribution of author

An attempt was also made to analyze the chemical literature based on the data from Chemical Abstracts. The Fig. 11 shows the growth trend with its R2. The growth rate is 5.98.

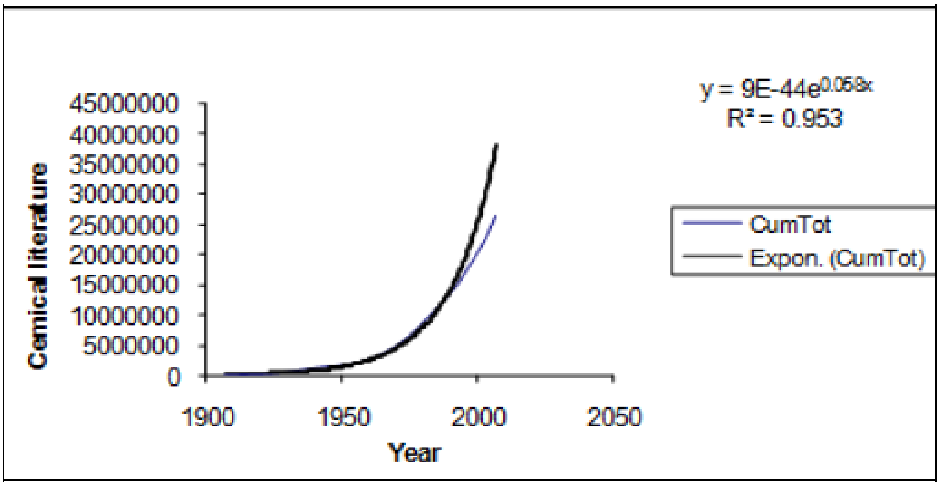

Fig. 11: Growth of chemical literature

5.6. OBSOLESCENCE OF LITERATURE

'Obsolete' generally means out of date or no longer in use. The process of being obsolete is known as obsolescence. It is also often referred to as the 'phenomenon of replacement.' The term obsolescence is used for the first time by Gross and Gross in 1927. The authors analyzed the references in the 1926 volume of the journal of chemical literature and observed that the number of references falls to one-half in fifteen years. Obsolescence is thus a characteristic of scientific and technical literature. Burton and Kebler (1960) are the first to use the term 'half-life' 1960. It is defined as 'the time during which one-half of all the currently active literature is published.' It is the period of time needed to account for one-half of all the citations received by a group of publications. The concept of half-life is always discussed in the context of diachronous studies. More precisely, Line and Sandison (1974) refer to diachronous studies as those that follow the use of particular items through successive observations at different points in time, whereas synchronous studies are concerned with the plotting the age distribution of material used at one point in time. However, there is no reason to suppose that the half-life for some subjects is the same as the median citation age in that subject. Half-life in the context of synchronous data is referred to as the median age of the citations/references. The use of literature may decline much faster with data of ephemeral relevance if it is in the form of reports, thesis, advanced communication or pre-print and in the context of advancing technology. However, the use of literature may decline slowly when it is descriptive (e.g., taxonomic botany) and critical (e.g., literary criticism); it may also decline if it deals with concepts (e.g., philosophy). Brookes in one of his articles (1970) argued that if growth rates of literature and contributors are equal then the obsolescence rate remain constant. In this sense growth and obsolescence are related. Ravichandra Rao and Meera (1991) have studied the relation between growth and obsolescence of literature, particularly in mathematics.

Gupta (1998) studied the relationship between growth rates and obsolescence rates and the half-life of theoretical population genetics literature. He explored the application of lognormal distribution to the age distribution of citations over a period of time. In the analysis of obsolescence, Brookes argued that the geometric distribution expresses the idea that when a reference is made to the particular periodical of age t years. The geometric distribution is given by

$(1\text{-}a)\ a^{t-1}$,

'a (< 1)' is a parameter – the annual aging factor; it is assumed to be constant overall values of t.

Let $U = 1 + a^2 + a^3 + a^4 + \ldots. + a^t + \ldots.$

i.e., $U = 1/(1\text{-}a)$.

Similarly if $U(t) = a^t + a^{t+1} + a^{t+1} + a^{t+2} + \ldots\ldots = a^t\,(U(0)$,

then $U(t)/U(0) = a^t$.

Using this relation, by graphical method, we can compute half-life as well as 'a'.

5.7. RELATION BETWEEN GROWTH RATE AND OBSOLESCENCE RATE

If we assume the literature is growing exponentially at an annual rate of g, we then Have $R(T) = R(0)e^{gT}$,

where R(T) is the number of references made to the literature during the year T.

We also have

$U(0) = R(0)/(1\text{-}a^0)$ and $U(T) = R(T)\ )/(1\text{-}a^T)$

where a^0 and a^T are the annual aging factors corresponding to the years 0 and T respectively.

Under the assumption that utility remains constant (U(0) = U(T)), we then have

$R(0)/(1\text{-}a^0) = R(T)\ )/(1\text{-}a^T)$

By substituting the value of R(T), we thus have a relation between growth and obsolescence:

$\mathbf{e^{gT} = (1\text{-}a^T)/(1\text{-}\ a^0)}$

However, Egghe and Ravichandra Rao (1992) showed that the obsolescence factors (aging factors) 'a' is not a constant, but merely a function of time. The authors have also shown that the function 'a' has a minimum that is obtained at a time t later than the time at which the maximum the number of citations is reached. Egghe (1993) also developed a model to study the influence of growth on obsolescence. He found different results for the synchronous and diachronus study. He argued that an increase in growth implies an increase in obsolescence for the synchronous case and for the diachronous case, it is quite opposite. In order to derive the relation, he also assumed the exponential models for growth as well as for obsolescence. In another paper, for the diachronous aging distribution and based on a decreasing exponential model, Egghe derived the first citation distribution. In his study, he assumed the distribution of the total number of citations received confirms a classical Lotka's function. The first citation distribution is given by

$$\phi(t_1) = \gamma (1 - a^{t_1})^{\alpha - 1}$$

where γ the fraction of papers that eventually get cited; t_1 is the time of the citation, 'a' is the aging rate and α is Lotka's exponent. Egghe and Ravichandra Rao in their study in 2002 observed that the cumulative distribution of the age of the most recent reference distribution is the dual variant of the first citation distribution. This model is different from the first citation distribution. In another study, Egghe and Rao have shown the general relation between the first citation distribution and the general citation age distribution. They have shown that if Lotka's exponent $\alpha = 2$, both distributions are the same. In the same study, they argued that the distribution of the n^{th} citation is similar to that of the first citation distribution. Egghe, Rao, and Rousseau (1995) studied the influence of production on utilization function. Assuming an increasing exponential function for production and a decreasing one for foraging, the authors have shown that in the synchronous case, the larger the increase in production, the larger the obsolescence; however, for the diachronous case it is quite opposite. This proof is different from the earlier one derived by Egghe (1993).

5.8. SUMMARY

Most of the studies on the growth of literature or obsolescence of literature are empirical in nature. Once we identify a suitable model to explain the empirical data on the growth of literature or obsolescence of literature, we can apply regression analysis (to fit either the linear or non-linear model to the observed data). Then, by applying the appropriate statistical tests (usually, by considering the R^2 value), we may choose a model to explain the data. Any study in scientometrics must be based on certain guidelines/ methodologies; in order to accept its validity as well as its generalization of the result. The general guidelines are:

- Identify the general problem(s)
- Conduct literature search
- Decide the design methodology
- Collect the data either for the population or for a sample
- Analyze the data
- Report the result
- Refine the hypotheses

In Step 5, to analyze the data we may adopt one of the models which are discussed in this Unit. Scientometric techniques have evolved over time and are continuing to do so. The counting of papers with attribution (by country, by institution, by author, etc.) is a part of scientometrics. It has been argued that the growth of entities (such as journals, articles, authors, etc.) follows an exponential model; however, it has been observed that it is not always true; so, there is a need to identify a suitable model to explain the data related to the growth of scientometric entities in general and also to study the data on the obsolescence of literature.

5.9. MCQ QUESTIONS

1. Robert Malthus is associated with A. Gompertz Model B. Linear Model C. Exponential Model

2. If the approximate trend, when plotted on semi-logarithmic paper is a straight line, use an A. Gompertz Model B. Linear Model C. Exponential Model D. Logistic Model

3. If the first difference (difference of two consecutive y values) resembles a normal frequency curve, use A. Gompertz Model B. Ware'sModel C. Exponential Model D. Logistic Model

4. Derek J de Solla Price argued that A. Scientific literature grows linearly B. Scientific literature grows exponentially C. Power model is the most suitable to explain the literature growth

5. Growth of science communication is attributed to three factors/ to which of the following do not belong? A. Scientific literature B. Scientific Manpower C. Science Temper

6. Scientific Literature grows linearly. False/True

7. The equivalent concept to time for a material undergoing a constant negative relative growth rate or exponential decay True/False

8. As the growth rate increases, the doubling time increases. False/True

9. The logistic growth of knowledge over a period of time is a result of a number of Applications of intellectual innovations. True/False

10. Obsolescence refers to the fields of study that are no longer used. True/False

11. Derek J de Solla Price is the first one to observe that the literature grows _________ Exponentially, Normal Distribution, Logistic Curve

12. Exponential growth represents an increase in a ___________ proportion of the total population for each unit of time. Varies with time, Fixed, Constant

13. In an exponential model (y t = a*b t), (b-1)*100 is the -- -- -- -- -- -- -- Growth Rate, Obsolescence,

14. Citation-based indicators cannot identify A. Productivity of a research unit B. Influence of a research group C. Intellectual linkages in a research area D. Impact of an author's work

15. As the growth rate increases, the doubling time increases. False

16. An ___________ collaboration occurs when institutions from two or more countries join hands. International

17. __________is the country that has the highest number of collaborating partners in the world.

18. Statistical data indicate that percentage of research produced by teamwork is A. Growing steadily B. is constant C. is decreasing.

19. The rate of growth of collaboration A. is field independent B. is field dependent C. none of the two.

20. The rate of growth of collaboration A. does not differ from country to country B. differs from one country to another country C. none of the two.

5.10. SHORT QUESTIONS

What type of growth curve has a S shape?

What is an obsolescence rate?

What is Literature Obsolescence?

What is a linear and exponential model?

What is an example of doubling time?

5.11. LONG QUESTIONS

Why is obsolescence important?

What is the concept of doubling time? Explain with suitable examples.

Keywords: Obsolescence rate; Literature obsolescence**;** Exponential model; Doubling time

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UNIT 6
OBSOLESCENCE FACTOR

6.0. OBJECTIVES

- To discuss the meaning, definition, and concept of obsolescence factors.
- To identify the types of Obsolescence factors.
- To show the steps and methodology to calculate obsolescence factors.
- To explain the application of obsolescence factors in the Collection Development of the library.
- To show the methodology for using Semi log graph to get obsolescence factors.

6.1. OUTCOME OF LEARNING

After completion of this module, you will be familiar with various concepts of obsolescence in literature; you have learned how to compute various parameters such as obsolescence factor, utility factor, half-life, etc; you are also now familiar with exponential distribution, geometric distribution, etc.

6.2. STRUCTURE OF UNIT

- Introduction
- Meaning and Definition
- Types of Obsolescence
- A theoretical framework for the Obsolescence factors
- Worked out Example
- Summary
- References

6.3. INTRODUCTION

'Obsolete' generally means out of date or no longer in use. The process of becoming obsolete is known as obsolescence. It is also often referred to as the 'phenomenon of replacement.' The term obsolescence was used for the first time by Gross and Gross in 1927. They analyzed the references in the 1926 volume of the Journal of Chemical Literature and observed that the number of references fell to one-half in fifteen years. Obsolescence is thus a characteristic of scientific and technical literature. Thus, obsolescence means decreasing the value of functional and physical assets or the value of a product or facility from technological changes rather than deterioration. Every newborn grows old and eventually dies. This is universally accepted as truth. So, perplexity sets in when sometimes it is reported that "life expectancies may not always decrease as organisms grow older". It was reported in Science and quoted in the Times of India dated 30th Oct. 1992 that the results of certain experiments on fruit flies indicated that once a fly was passed a certain age, its life expectancy may increase with age. Is this consistent with the universal truth stated in the first line above? Such seeming anomalies may be reconciled only through a detailed study of the phenomenon of ageing.

The concept of obsolescence is of obvious interest to information theoreticians who concern themselves with the development of careers and librarians who administer growing collections of infinite spaces. Such librarians look to research on obsolescence to help them decide which item to keep and which to store or discard in order to make room for new acquisitions. Increased periodical costs have made it imperative to cancel some subscriptions and librarians have turned once again to obsolescence research in hope that the concept can be employed to forecast the future as well as to describe the current or past use.

6.4. MEANING AND DEFINITION

Obsolescence means the decreasing value of functional and physical assets from technological change rather than deterioration. It is characterized by terminology and metaphors that link inevitable organic (aging or decay) or scientific phenomenon (half-life) to the phenomenon of changing use or published literature over a period of time. In other words, obsolescence is a decline in the usage of literature over a period of time. When the use of a document ceases, it is termed as obsolete.

6.5. TYPES OF OBSOLESCENCE

Actually, obsolescence implies a relation between time and use but the effect of time is revealed in different ways. The impact of time on the use of documents can be studied in two ways: namely synchronous studies and dia-chrounus studies (Line, 1970). Synchronous studies are made on records of uses or references at one point in time and compress the uses against the age of distribution of the materials used or cited. With respect to obsolescence studies majority of the studies have used citations, records of consultations, or loans.

In the synchronous study, the citations are counted backwards i.e. references in a journal article are examined to find out how many references have been cited for that particular year. Like, year-wise references are analyzed. Half-life annual aging factors and utility factors are studied with this type of study. The half-life of a journal article is the time during which half of all the currently active literature was used. The median age distribution in other words is half-life. In the diachronous study, the successive observations at different times are made by counting the citations in a forward direction i.e. counting the citations that an article or journal published in 2005 is going to get in the years 2006, 2007…etc. This type of study helps in determining the rate at which the citations decline in the future. Many studies have been undertaken in this field. Some of the notable studies in the field are Gros and Gross (1927), Burton and Kessler (1960), Kent and Others (1979), Jain (1966), Brookes (1970), Line (1970, 1974) Ravichandra Rao (1971), Sangam (1989), Moed (1998), Gupta (1997,1998), etc. While studying and reviewing the studies in the field of obsolescence, it is observed that very few studies have been done. Though new indicators and methods are being developed and applied to study obsolescence, the case studies are found to be very less. In the present study, an attempt has been made to identify the obsolescence factors and patterns in the field of chemical science.

6.6. THEORETICAL FRAMEWORK FOR THE OBSOLESCENCE FACTORS

Burton and Kebler (1960) were the first to use the term 'half-life' as applied to documents in 1960. It is defined as 'the time during which one-half of all the currently active literature is published.' It is the period of time needed to account for one-half of all the citations received by a group of publications. The concept of half-life is always discussed in the context of diachronous studies. More precisely, Line and Sandison (1974) refer to diachronous studies as those that follow the use of particular items through successive observations at different points in time, whereas synchronous studies are concerned with plotting the age distribution of material used at one point in time. However, there is no reason to suppose that the half-life for some subjects is the same as the median citation age in that subject. Half-life is the context of synchronous data and is referred to as the median age of the citations/references. The use of literature may decline much faster with data of ephemeral relevance if it is in the form of reports, thesis, advanced communication, or pre-print and in the context of advancing technology. However, the use of literature may decline slowly when it is descriptive (e.g., taxonomic botany) and critical (e.g., literary criticism). Brookes (1970) in one of his articles argued that if growth rates of literature and contributors are equal then the obsolescence rate remains constant. In this sense growth and obsolescence are related. Ravichandra Rao and Meera (1991) studied the relationship between growth and obsolescence of literature, particularly in mathematics. Gupta (1999) studied the relationship between growth rates and obsolescence rates and the half-life of theoretical population genetics literature. He observed that the lognormal distribution fits very well with the age distribution of citations over a period of time.

In the analysis of obsolescence, Brookes (1970) argued that the geometric distribution expresses the idea that when a reference is made to a particular periodical of age t years (1-a) a_{t-1} . 'a (< 1)' is a parameter – the annual aging factor; it is assumed to be constant over all values of t. Let U = 1 + a_2 + a_3 + a_4 + …. + a_t + …. i.e., U = 1/(1- a). Similarly, if U(t) = a_t + a_{t+1} + a_{t+1} + a_{t+2} + …… = a_t (U (0), then U(t)/U (0) = a_t. Using this relation, by graphical method, we can compute half-life as well as 'a'. If we assume that the literature is growing exponentially at an annual rate of g, we then have R(T) = R (0) e_{gT}, where R(T) is the number of references made to the literature during the year T. We also have

U (0) = R(0)/(1-a_0) and U(T) = R(T)/(1-a_T)

Where a_0 and a_T are the annual aging factors corresponding to the years 0 and T respectively. Under the assumption that utility remains constant (U (0) = U(T)), we have R(0)/(1-a_0) = R(T))/(1-a_T). By substituting the value of R(T), we get a relationship value between growth and obsolescence:

$$e^{gT} = (1-a_T)/(1- a_0)$$

However, Egghe and Ravichandra Rao (1992) showed that the obsolescence factors (aging factors) 'a' is not a constant, but merely a function of time. They have also shown that the function 'a' has a minimum that is obtained at a time t later than the time at which the maximum of number of citations is reached. Egghe (1993) developed a model to study the influence of growth on obsolescence. He obtained different results for the synchronous and diachronus studies. He argued that an increase in growth implies an increase in obsolescence for the synchronous case and for the diachronous case, it is quite the opposite. In order to derive the relationship, he also assumed the exponential models for growth as well as for obsolescence. In another paper, for the diachronous aging distribution and based on a decreasing exponential model, Egghe (2000) derived the first citation distribution. In his study, he assumed the distribution of the total number of citations received conforms to a classical Lotka's function (16). The first citation distribution is given by

ϕ (t_1) = γ (1- a $_{t1}$)$_{\alpha-1}$

where γ is the fraction of papers that eventually get cited; t_1 is the time of the citation, 'a' is the aging rate and α is Lotka's exponent. Egghe and Ravichandra Rao (2002) in their study in 2002 observed that the cumulative distribution of the age of the most recent references is the dual variant of the first citation distribution. This model is different from the first citation distribution. In another study, Egghe and Rao (2001) have shown the general relation between the first citation distribution and the general citation age distribution; if Lotka's exponent α = 2, both these distributions are the same. In the same study, they argued that the distribution of the n_{th} citation is similar to that of the first citation distribution. Egghe, Rao, and Rousseau (1995) studied the influence of production on utilization function. Assuming an increasing exponential function for production and a decreasing one for foraging, these authors have shown that in the synchronous case, the greater the increase in production, the greater the obsolescence; however, for the diachronous case it is quite the opposite. This proof is different from the earlier one derived by Egghe.

The study of obsolescence, in practical terms, is related to changes in the use of documents over time. Line and Sandison (1974), Jain (1966a, 1966b), Kent et al. (1979) in their Pittsburgh study; and FussIer and Simon (1969) attempt to prove the hypothesis that used declines over time. Line and Sandison, however, argued that this hypothesis is to be tested first and should not be made as a starting assumption. Brookes (1970) claims that; the decline of use over time conforms closely to a negative exponential distribution. He hypothesizes that the number of references to an issue is a function of its age~, and he assumes the function to be a geometric distribution:

$$p(t) = (1-a)a^t \qquad 0 \leq t \leq \infty \quad \text{and} \quad 0 \leq a \leq 1.$$

p(t) is the probability mass function of reference to an issue of the journal of age t years; if R references are made to a given periodical during its first year of life, then references can be expected during its second year, a^2Rreferences can be expected during its third year, and so on. Under the assumption that a is constant for all values of and for a <1, the series a^t converges to the sum, $\frac{1}{1-a}$ as $t \to \infty$. Therefore, the total number of references that will be made to it during its infinite lifetime is

$$p(o) = \frac{R}{1-a}$$

If the periodical is t years old, then the number of further references to it can be computed by:

$$U(t) = \sum_{i=t}^{\infty} p(t) = \frac{Ra^t}{1-a} = a^t U(0)$$

U(o)is called the total utility of a periodical which has just been published. Brookes (1970) suggests a graphical method for computing a. The function is called the utility factor of the periodicals. Under the assumption that the literature is growing exponentially at an annual rate of growth g, we have:

$R(T) = Re^{gt}$

where R(T)is the number of articles at time T and R is the number of articles at time T=O. Brookes (1970) and also Line (1970) have discussed the computational aspects of half-life, utility factor, etc. in their articles. Below a worked-out example has been given in this regard.

6.7. WORKED OUT EXAMPLE

We considered a synchronous approach to collect the data for obsolescence analysis. The citation appended to the articles published in the following two journals

- Indian Journal of Experimental Biology (CSIR), New Delhi
- Asian Journal of Chemistry” New Delhi.

were considered as source data. We have collected the dta for five years (2001-2005). For computation of obsolescence rate, the graphical method as explained by Brookes may be used. The data is given in Table 2. Table 1 gives the summary of the data. Below, an attempt has been made to fit the exponential distribution, to compute the ageing factor, utility factor and half-life.

Table 1: Average Citation Rate of Journals

Year	Asians Journal of Chemistry			Indian Journal of Exp. Biology		
	Articles	References	Citation ate	Articles	References	Citation Rate
2001	276	1409	5.11	378	4735	12.53
2002	271	1583	5.66	314	4494	14.31
2003	302	1783	5.90	278	3772	13.57
2004	295	1878	6.37	297	3009	10.13
2005	351	2470	7.04	265	5059	19.09
Total	**1495**	**9073**	**6.02**	**1534**	**22069**	**13.926**

Some Observation: Out of 30142 references 38% are received for the publications of the last 10 years; 69.57% for the last two decades; 93 % for the last four decades, 99.10% citations are received for the last 6 decades and only 0.9% are for the other decades which are 269 in number. Half of the citations have been produced up to the age of 13 years (15180). The maximum number of references has been observed in the year 2000 (1562 i.e. 5.08%) followed by 1998 (1530), 1996 (1510), and 1997 (1501). This shows that scholars are using current information for their research purposes. More than 117 articles are from the age of more than 71 to 105 years.

6.8. TEST OF EXPONENTIALLY OF CITATION DISTRIBUTION

The data of column 5 of table-3 are plotted as frequency polygon 'AA'. The curve AA looks like a negative exponential distribution. The data indicates a roughly declining trend in the frequency citations as against the cited ages. The points are concentrated at one end and the curve tapers off gradually to years at the other end while an initial build-up occurs from the first entry (t = 0). With the help of table 3 the values of and σ are calculated; Mean =17.06234; Variance =159.2974; SD =12.62131; also, in order to test the exponentially of the distribution, another test i.e. Kolmogorov-Smirnov Test (K-S Test), is applied. The observed value of cumulative citation frequencies are calculated and presented in column 6 of Table-3. The calculation of the estimated values: -

$F(x)=l-e^{\Theta x}$...................(1)

Where x = 0,1,2,3,4,5 ,........

and $\emptyset = \frac{1}{x}$

The estimated values using (10 are presented in column 7 (represented as E(x) in Table-3.To test the exponentiality of the distribution, K-S test is used. According to this test, the maximum deviation in observed and estimated values, 'D' is calculated as follows:

Table 2: Citation Frequency Distribution of Journals

Year	Age (x)	Citations	Cumulative Citations	Tail	% of Citations	% Cumulative Citations
2005	0	15	15	30142	0.049764	0.049764
2004	1	191	206	30127	0.633667	0.683432
2003	2	410	616	29936	1.360228	2.04366
2002	3	761	1377	29526	2.524716	4.568376
2001	4	1221	2598	28765	4.050826	8.619202
2000	5	1562	4160	27544	5.182138	13.80134
1999	6	1497	5657	25982	4.966492	18.76783
1998	7	1530	7187	24485	5.075974	23.84381
1997	8	1501	8688	22955	4.979762	28.82357
1996	9	1510	10198	21454	5.009621	33.83319
1995	10	1276	11474	19944	4.233296	38.06649
1994	11	1306	12780	18668	4.332825	42.39931
1993	12	1278	14058	17362	4.239931	46.63924
1992	13	1122	15180	16084	3.722381	50.36162
1991	14	1070	16250	14962	3.549864	53.91149
1990	15	971	17221	13892	3.221419	57.1329
1989	16	882	18103	12921	2.92615	60.05905
1988	17	757	18860	12039	2.511446	62.5705
1987	18	734	19594	11282	2.43514	65.00564
1986	19	716	20310	10548	2.375423	67.38106
1985	20	662	20972	9832	2.196271	69.57733
1984	21	723	21695	9170	2.398646	71.97598
1983	22	595	22290	8447	1.97399	73.94997
1982	23	553	22843	7852	1.834649	75.78462
1981	24	529	23372	7299	1.755026	77.53965
1980	25	475	23847	6770	1.575874	79.11552
1979	26	479	24326	6295	1.589145	80.70466
1978	27	444	24770	5816	1.473028	82.17769
1977	28	396	25166	5372	1.313781	83.49147
1976	29	333	25499	4976	1.104771	84.59624
1975	30	359	25858	4643	1.191029	85.78727
1974	31	386	26244	4284	1.280605	87.06788
1973	32	311	26555	3898	1.031783	88.09966
1972	33	272	26827	3587	0.902395	89.00206
1971	34	254	27081	3315	0.842678	89.84473
1970	35	284	27365	3061	0.942207	90.78694
1969	36	239	27604	2777	0.792914	91.57986
1968	37	230	27834	2538	0.763055	92.34291
1967	38	178	28012	2308	0.590538	92.93345
1966	39	189	28201	2130	0.627032	93.56048
1965	40	143	28344	1941	0.474421	94.0349
1964	41	135	28479	1798	0.44788	94.48278
1963	42	100	28579	1663	0.331763	94.81454
1962	43	127	28706	1563	0.421339	95.23588
1961	44	159	28865	1436	0.527503	95.76339
1960	45	91	28956	1277	0.301904	96.06529
1959	46	104	29060	1186	0.345034	96.41032
1958	47	101	29161	1082	0.335081	96.74541
1957	48	100	29261	981	0.331763	97.07717
1956	49	80	29341	881	0.26541	97.34258
1955	50	64	29405	801	0.212328	97.55491
1954	51	66	29471	737	0.218964	97.77387
1953	52	72	29543	671	0.238869	98.01274
1952	53	65	29608	599	0.215646	98.22839
1951	54	53	29661	534	0.175834	98.40422
1950	55	44	29705	481	0.145976	98.5502
1949	56	49	29754	437	0.162564	98.71276
1948	57	47	29801	388	0.155929	98.86869
1947	58	27	29828	341	0.089576	98.95826
1946	59	27	29855	314	0.089576	99.04784
1945	60	18	29873	287	0.059717	99.10756
1944	61	20	29893	269	0.066353	99.17391
1943	62	12	29905	249	0.039812	99.21372
1942	63	22	29927	237	0.072988	99.28671
1941	64	14	29941	215	0.046447	99.33316
1940	65	20	29961	201	0.066353	99.39951
1939	66	12	29973	181	0.039812	99.43932
1938	67	19	29992	169	0.063035	99.50236
1937	68	16	30008	150	0.053082	99.55544
1936	69	7	30015	134	0.023223	99.57866
1935	70	10	30025	127	0.033176	99.61184
	71	117	30142	117	0.388163	100
Total		**30142**			100	

D = |F(x)-E_n(x)|. At the 0.01 level of significance, the K-S statistics is equal to 1.63/ $n^{1/2}$. If 'D' is greater than K-S statistics; than the distribution does not fit the theoretical distribution at this level of significance. In this case n =71, hence K-S statistics for the 0.01 level should be 1.63/$70^{1/2}$

=0.1948 and the value of 'D' should not exceed this. The examination of the data of column 6, 7 and 8of table-3 reveals that 'D' value does not exceed the 0.1948 limits, Theeta value 0.058609 and D value is 0.193445and hence it confirms statistically that the distribution of the data follows negative exponential distribution.

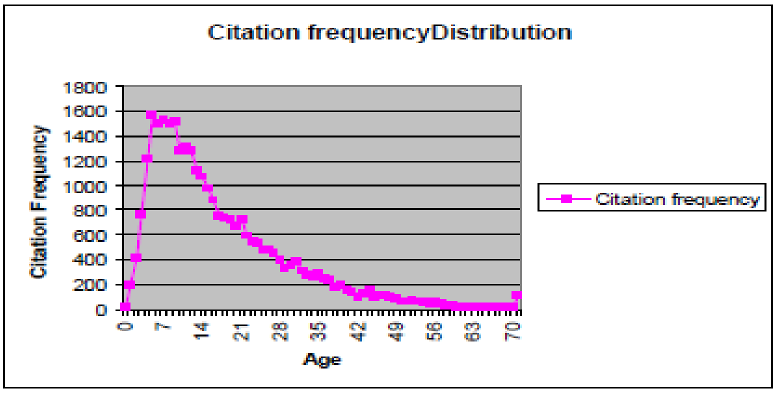

Fig.1: Citation Frequency Distribution

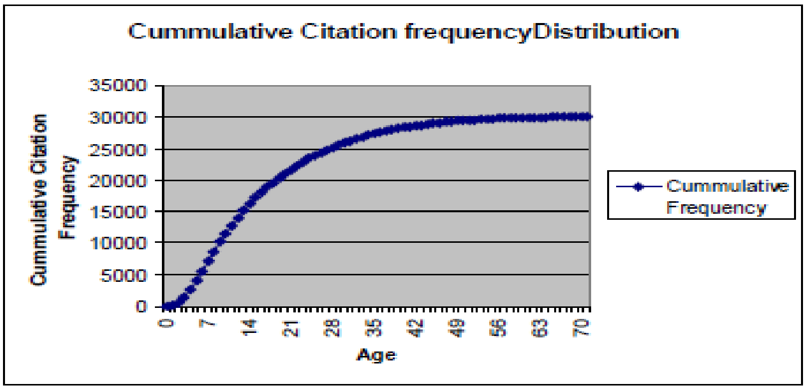

Fig.2: Cumulative Citation frequency Distribution

Based on the negative exponential function over time or obsolescence annual ageing factor is the ratio of the percentage of non-used (or used) documents in successive years. In case of citations this may be measured in proportion to a number of citations received in a library context. The AAF = "a" has been calculated graphically, following the procedure suggested by Brookes.

- The data of column 5 of table-3are plotted on semi-log paper.
- On axis 'X' (linear scale), the values of citation ages, that is, of 't'
- In years are taken, starting with the year 2005 (t = 0), as the base year, the values were taken from t = 0 to t = 71;
- On the 'Y' axis, on to left-hand side, the values of cumulative citations from "Tail" that is, 30142 for 2005, are taken on a log scale,
- The resultant line by joining the maximum point on a straight time, 'XY' is plotted;
- For convenience sake, a parallel line to 'XY' is drawn from the point 'T' (t) =10,000; on this line T(t) for t =1 gives the value of T(l) = a_1 = a the Annual Aging Factor;
- The value of 'a' from this line, directly reads from the graph in figure ' 28' is equal to '0.94' approximately;
- The scale on the left hand is graduated to find out different values of 'a' directly from graph, from 1.0 to 0.1;

- The time 'OA' reads the values of t = 0 to t = 20; and value for 'A' on the line at the extreme right is 0.1.
- Taking this value to the left hand side, another line O 'A' is drawn parallel to 'XY'.
- Similarly, the parallel lines could be drawn to head the value for the values more than 70 years.
- It could be observed from these lines that only one straight line is not possible for the whole data. There may be a few more lines depending upon the nature of literature of a specific subject at a particular time.

The values of 'a' thus should be calculated by using the following formula:
$T(t) = a_t$
The value as read directly from the graph for t = 1, is found to be 0.94

The value of using parallel 'OA'
$a_6 = 0.77$
6 log (a) = log (0.77)
by solving this equation we get,

log a = log (0.77) /6
= - 0.04356
a = e - 0.957374
Therefore,
a = 0.957374

The average value of 'a' can be taken as,
a =0.94 + 0.957374 /2
= 0.948687
Therefore, **A A F =0. 0948687**

6.8.1. Half-life

The time calculated/ expected during which half the use of individual articles constituting literature has been or expected to be made. The half-life can be determined from the graph in such a way that relation a_h= 0.5 will hold well. The value as observed from the graph is 15 years. As calculated from the above relation, h = 13.15865 years which is almost near to the observed value. The half-life for the value of 'a' of chemical science journals literature can be calculated as follows,

Log $(0.948687)^h$= log 0..5
h log 0.948687 = h log 0.5
we get the equation as
-0.69315/- 0.05268
h = 13.15865

Table 3: Citation Frequency Distribution of Journals and Parameter values

Year	Age	Citations	%	Cumulative	F(x)	E(x)	D
	x	f(x)	xf(x)	$x^2f(x)$	Observed		
2005	0	15	0	0	0.000498	0	0.000498
2004	1	191	191	191	0.006337	0.056924	0.050588
2003	2	410	820	1640	0.013602	0.110608	0.097006
2002	3	761	2283	6849	0.025247	0.161236	0.135989
2001	4	1221	4884	19536	0.040508	0.208982	0.168474
2000	5	1562	7810	39050	0.051821	0.25401	0.202189
1999	6	1497	8982	53892	0.049665	0.296475	0.24681
1998	7	1530	10710	74970	0.05076	0.336522	0.285763
1997	8	1501	12008	96064	0.049798	0.37429	0.324493
1996	9	1510	13590	122310	0.050096	0.409908	0.359812
1995	10	1276	12760	127600	0.042333	0.443499	0.401166
1994	11	1306	14366	158026	0.043328	0.475177	0.431849
1993	12	1278	15336	184032	0.042399	0.505052	0.462653
1992	13	1122	14586	189618	0.037224	0.533227	0.496003
1991	14	1070	14980	209720	0.035499	0.559798	0.524299
1990	15	971	14565	218475	0.032214	0.584856	0.552642
1989	16	882	14112	225792	0.029261	0.608487	0.579226
1988	17	757	12869	218773	0.025114	0.630774	0.60566
1987	18	734	13212	237816	0.024351	0.651792	0.627441
1986	19	716	13604	258476	0.023754	0.671613	0.647859
1985	20	662	13240	264800	0.021963	0.690307	0.668344
1984	21	723	15183	318843	0.023986	0.707936	0.683949
1983	22	595	13090	287980	0.01974	0.724561	0.704821
1982	23	553	12719	292537	0.018346	0.74024	0.721894
1981	24	529	12696	304704	0.01755	0.755027	0.737477
1980	25	475	11875	296875	0.015759	0.768972	0.753213
1979	26	479	12454	323804	0.015891	0.782123	0.766231
1978	27	444	11988	323676	0.01473	0.794525	0.779795
1977	28	396	11088	310464	0.013138	0.806222	0.793084
1976	29	333	9657	280053	0.011048	0.817252	0.806205
1975	30	359	10770	323100	0.01191	0.827655	0.815745
1974	31	386	11966	370946	0.012806	0.837466	0.82466
1973	32	311	9952	318464	0.010318	0.846718	0.8364
1972	33	272	8976	296208	0.009024	0.855443	0.846419
1971	34	254	8636	293624	0.008427	0.863672	0.855245
1970	35	284	9940	347900	0.009422	0.871433	0.86201
1969	36	239	8604	309744	0.007929	0.878751	0.870822
1968	37	230	8510	314870	0.007631	0.885653	0.878023
1967	38	178	6764	257032	0.005905	0.892162	0.886257
1966	39	189	7371	287469	0.00627	0.898301	0.89203
1965	40	143	5720	228800	0.004744	0.90409	0.899346
1964	41	135	5535	226935	0.004479	0.90955	0.905071
1963	42	100	4200	176400	0.003318	0.914698	0.911381
1962	43	127	5461	234823	0.004213	0.919554	0.915341
1961	44	159	6996	307824	0.005275	0.924133	0.918858
1960	45	91	4095	184275	0.003019	0.928452	0.925433
1959	46	104	4784	220064	0.00345	0.932525	0.929075
1958	47	101	4747	223109	0.003351	0.936366	0.933015
1957	48	100	4800	230400	0.003318	0.939988	0.936671
1956	49	80	3920	192080	0.002654	0.943404	0.94075
1955	50	64	3200	160000	0.002123	0.946626	0.944503
1954	51	66	3366	171666	0.00219	0.949664	0.947475
1953	52	72	3744	194688	0.002389	0.95253	0.950141
1952	53	65	3445	182585	0.002156	0.955232	0.953075
1951	54	53	2862	154548	0.001758	0.95778	0.956022
1950	55	44	2420	133100	0.00146	0.960183	0.958724
1949	56	49	2744	153664	0.001626	0.96245	0.960824
1948	57	47	2679	152703	0.001559	0.964588	0.963028
1947	58	27	1566	90828	0.000896	0.966603	0.965708
1946	59	27	1593	93987	0.000896	0.968504	0.967609
1945	60	18	1080	64800	0.000597	0.970297	0.9697
1944	61	20	1220	74420	0.000664	0.971988	0.971325
1943	62	12	744	46128	0.000398	0.973583	0.973185
1942	63	22	1386	87318	0.00073	0.975086	0.974357
1941	64	14	896	57344	0.000464	0.976505	0.97604
1940	65	20	1300	84500	0.000664	0.977842	0.977179
1939	66	12	792	52272	0.000398	0.979103	0.978705
1938	67	19	1273	85291	0.00063	0.980293	0.979663
1937	68	16	1088	73984	0.000531	0.981415	0.980884
1936	69	7	483	33327	0.000232	0.982473	0.98224
1935	70	10	700	49000	0.000332	0.98347	0.983139
	71	117	8307	589797	0.003882	0.984411	0.98053
Total		**30142**	**514293**	**13576583**			**0.983139**

Annual Ageing Factor (=AAF)

Utility factor (U)

Utility factor can be calculated by using the relationship, u - 1/1 -a
U=l/(l-a)
=1/1-0.948

U = 19.48831

Mean

The value of the mean (m) can be calculated from the value of AAF by using following formula,
$1/m = \log_e a = \log_e 1/a$ and $a = 0.948$
$\log_e a = \log_e 1/0.948$
$1/m = 0.052676$
$m = 18.98392$

Both values (frequency table value 17.06234 and 18.98392) being almost the same, confirm the exponential nature of the distribution and also justify the correctness of the average value of 'a' and this finding proves that citation frequency distribution in chemical science journals follows exponential pattern.

Corrected Obsolescence Factor (a)

The corrected obsolescence factor is the factor by which the active life of an individual article on a set of documents tends to delay annually. It has been calculated by using the following formulae,

$ά = (0.5)_{1/m} = (0.5)_{0.052676}$
$ά = 0.1.037187$
U -m=**19.48831**-18.98392= 0.504389

6.9. SUMMARY

Indian J Experimental Biology has received 22069 references for 1534 articles at the average of 13.926 citations per article while Asian Journal of Chemistry has received 9073 references for 1495 articles at the average of 6.02 references per article Over all, these two journals have received 30,142 references for 3,027 articles at the rate of 9.95 references per article for 5 year data. The Annual Ageing Factor (AAF) = "a" as calculated from the graph is found to be A A F =0. 0948687. The value of half life as observed from the graph is 15 years. As calculated from the above relation, h = 13.15865 years which is almost near to the observed value. The value of Utility factor (U) is U = 19.48831. The value of the mean (m) is = 18.98392 which confirms the exponential nature of the distribution and also justify the correctness of the average value of ‘a’. Citation frequency distribution in chemical science journals follows exponential patter. The Corrected Obsolescence Factor (a) was found to be = 0.504389.

Findings of the Obsolescence factors are useful in understanding the researchers to what extent they can go back to obtain the required published information in their particular field of interest. In the evolution of life there is a theory called “use and disuse” which means the one always in use continuous to exist where as the one which is not in use perishes gradually. Similarly in the field of literature also the publication may go on decreasing with the advancement of age. The obsolescence studies are helpful in discarding older materials in libraries; decisions regarding back volumes of periodicals; predicting the future use of literature; serving as a tool to measure the citable or usable documents in the field of chemical science. Results of this study cannot be generalized with other subjects and subfields.

6.10. MCQ QUESTIONS

1. Obsolescence related to A. The increasing value of a product B. Decreasing value of the product C. Experience of Life D. Age of a library

2. Synchronous means: A. Set of references at a single point of time B. Psychological behaviour of a reader C. Decreasing use of a library D. Increasing use of Library

3. Diachrounus means A. Citations to books and Journals B. Set of references/ citations of a subject from the beginning to the end C. Increasing trend of references to a subject D. Decreasing trend of references to a subject

4. Obsolescence factors are useful in understanding the researchers: A. To what extent they can go back to obtain the required published information in their particular field of interest? B. To collect data C. To review literature in the field D. To compile a bibliography.

5. AAF can be calculated: A. Through plotted data on a semi-log graph. B. Through plotted data on simple graph C. Through plotted data on simple paper D. Through plotted data on three line graph

6. The term obsolescence is derived from the ______ word A. Greek term B. Latin C. Russian D. French

7. Higher the growth of literature higher the obsolescence as well as ____A. Lower the half-life B. Lower the library use C. Higher the half-life D. Higher the use of library

8. Obsolescence is a decline over time invalidity of the utility of information. True/False

9. Weeding Policy can be derived on the basis of obsolescence factors. True/False

10. Apparent obsolescence __________________________

11. Corrected Obsolescence ___________________

12. Half Life Half the use of total individual articles in a _________

13. Annual Aging ___________

14. The obsolescence rate of documents indicates the total life of a document from its publication True/False

15. Obsolescence refers to the fields of study that are no longer in use. True/False

16. In an exponential model (y t = a*b t), (b-1)*100 is the _______________

17. Bibliometric mapping is basically based on A. papers published in scientific journals B. technical reports C. book chapters

18. Number of publications is a measure of A. impact B. output C. visibility

19. Impact factor is a measure of A. output of a journal B. output of a country C. standing of a journal

20. Citation per paper is given by A. Number of citations/ number of papers B. Citations percent / publications percent C. (NIF) i j = {(GIF) i j / Max (GIF) i j} x 10

6.11. SHORT QUESTIONS

What do you mean by obsolescence?

What are the causes of obsolescence?

What is citation distribution?

What has been cited half-life of literature?

6.12. LONG QUESTIONS

What are the types of obsolescence? Explain with suitable examples.

What is the difference between obsolete and obsolescence?

KEYWORDS: Citation distribution; Half-life; Obsolescence

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UNIT 7
CITATION ANALYSIS

7.0. OBJECTIVES

- What is citation analysis?
- Tools for citation analysis;
- Classification of citations according to their nature and context;
- Reasons for citations;
- Bibliographic coupling and co-citations; and
- Applications of citation analysis and their limitations.

7.1. OUTCOME OF LEARNING

At the end of this module, you have gained knowledge in citation analysis, including the merits and demerits of citation data. The history of citation studies was also covered. You have also learned the methodology of citation analysis.

7.2. STRUCTURE OF UNIT

- Introduction
- Citation Index
- Nature of citations
- Classification of citations
- Reasons for citations
- Bibliographic coupling
- Co-citation
- Applications
- Limitations
- Summary
- References

7.3. INTRODUCTION

Citation analysis is the major thrust area of bibliometric research. It deals with the analysis of the bibliographic references which generally appear at the end of the scientific communication. When an author cites a paper (say X) in his paper (say Y), then X is called the cited paper and Y is the citing paper. Thus, citation analysis presents a connection between cited and citing documents. Analysis of cited and cited papers can provide valuable information about the existing and emerging knowledge on a subject. The more an article is cited, the more significant becomes the paper. Citation analysis can be used to study the influence of the research output of a country on world science. Science policymakers these days are using citation analysis to identify the most significant papers or authors or institutions in a discipline. Citation counts help a research administrator to assess the impact of the research output of each individual scientist of his organization, but also that of his organization as a whole. Citation analysis helps to identify those earlier researchers whose concepts, methods, apparatus, etc. were used by the authors in the preparation of his article.

Citations are very field dependent and the number of citations per paper varies from one discipline to another. Citations are high in the field of biomedical sciences. A relatively small, isolated field will attract fewer citations than either a more general field or research within a narrow field that has a wider focus of interest. A paper published in an obscure journal, or publication with a small readership usually has a low citation rate. About 80% of the references appended in a paper are to journal articles. Review journals have a relatively higher citation rate, because most review papers are long, contain many references, and are cited quite heavily; however, they are not necessarily very different in citations per page when differences are made in the length of the paper. Citation analysis also tells about what an author is recognized for (past work, methods, concepts or reviews). Authors of highly cited papers constitute the elite or leading scientists of the speciality. Citation analysis involves counting the number of citations to a particular paper for a period of years after its publication. The number of years for which the citations are counted is known as the citation window which may vary from one field to another.

7.4. CITATION INDEX

The practice of citation analysis received a considerable stimulus with the evolution of the Science Citation Index (SCI) developed by Eugene Garfield and brought out by the Institute of Scientific Information (now Thomson Reuters), USA. Till recently, it was the only database available for citation analysis. However, for the past few years, researchers have started using the SCOPUS database of Elsevier for the purpose of citation analysis. Both these databases are multidisciplinary international databases. SCI has grown from 600 journals in 1964 to more than 10,000 scientific and technical journals in most science disciplines now. Thomson Reuters also publishes Social Science Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI). SCOPUS originated in the year 2004 and claims to index about 15000 periodicals in science, technology and social sciences. International conferences are also indexed by these two databases. Both these indexes are now available online. Besides, the availability of these two commercial databases for citation analysis, Google Scholar is also being used to track the citations of individual authors, which is freely available on the Web.

A citation index is an ordered list of cited articles each of which is accompanied by a list of citing articles. The citing article is identified by a source citation and the cited article by a reference citation. The index is arranged by reference citations. Arrangement by the author is favoured in the citation index. Citation indexes have several problems like cost, various spellings of author names, authors with the same name, incorrect citing information, and other human errors. However, the advantages outweigh the disadvantages. SCI was also criticized for having a national bias in its coverage of journals as the number of journals originated from developing countries and countries publishing in languages other than English were less covered. However, in recent years this problem has been solved to a great extent by Thomson Reuters. SCOPUS took note of these problems before its launch and did not face such criticism.

7.5. NATURE OF CITATIONS

Based on the nature as who is the citer, citations have been classified into three categories (Folly et al 1981). These are:

7.5.1 Self-citations

Self-citation may be said to occur when at least one of the authors of a cited document is the same person as one of the authors of the citing document. The author's self-citation rate of an individual may be calculated by dividing the number of self-citations by the total number of all citations made by the individual. Self-citation may artificially inflate the citation rate.

7.5.2. Co-operational citations

The cited author under study and one citing author were co-authors prior to the publication of cited paper and criterion (i) does not hold; and

7.5.3. Independent citations

No detectable relations between cited and citing author are observed.

7.6. CLASSIFICATION OF CITATIONS

On the basis of citation context analysis, citations have been classified into four classes (Murugesan and Moravcsik 1978). These are as follows:

7.6.1. Conceptual vs. Operational (theory vs. method)

If a concept or theory of the cited paper is used directly or indirectly in the citing paper in order to lay the foundation to build on it or to contribute to the citing paper, then the citation is a conceptual one. In contrast, the definition of an operational reference involves the situation when a concept or theory is referred to as a tool to substantiate the author's claim (e.g. the author may compare his results based on his theory with the result of another theory) or to indicate alternative approaches. In addition, a reference is also called operational when it borrows mathematical or physical techniques, results, references, or conclusions from the cited paper.

7.6.2. Organic vs. Perfunctory (essential vs. non-essential)

"Organic" references are those from which concepts or theories are taken to lay the foundations of the citing paper, or papers from which certain results (including numerical ones) are taken to develop the ideas in the citing paper or papers which help to better understand certain concepts in the citing paper. In contrast "perfunctory" references are those which describe alternative approaches which are not utilized in the citing paper, references which are used to compare certain results or conclusions, and references which are used to indicate the fact that a certain method employed is routine in the literature and references which merely contribute to the chronological context of the citing paper. In short, perfunctory citations are not really necessary for the development of the citing paper.

7.6.3. Evolutionary vs. Juxtapositional (development of idea vs. contrasting idea)

A reference is called evolutionary if it provides a concept or theory to build on, a mathematical technique to use, or the results of an analysis which is used in the development of the citing paper. In other words, evolutionary references deal with material which contributes directly to the logical development of the subject of the citing paper. In contrast, a reference is called juxtapositional, if it refers to alternative approaches, gives mere references to works using the same general approach but which have branched off so that they do not contribute to the development of the citing paper, refers to other analyses used in the citing paper only to make comparisons, refers to other works which may help to clarify some ideas but do not contribute to the development of the citing paper, or refer to a paper only for references given in the later.

7.6.4. Confirmative vs. Negational (supports findings vs. opposes findings)

A reference is confirmative if the author of the citing paper considers the paper referred to as correct. Almost all evolutionary papers are also confirmative. In contrast, a negational reference describes the situation when the author of the citing paper is not certain about the correctness of the cited paper. There are two types of negational citations. In the first type, the author of the citing paper claims that the cited paper is incorrect. In the other type of negational citation, the author of the citing paper disputes the cited paper but cannot come to a definite conclusion, because the issue is still being tested experimentally or theoretically.

7.7. REASONS FOR CITATIONS

Besides scientific merit, **v**arious other factors influence the choice of references an author cites. It may be familiarity with particular papers or prominence of an author in a field, its availability or language, controversiality of the topic, reprint dissemination, and coverage by secondary services etc. Papers more than 5 years old are cited less frequently because these are superseded by books or reviews. Only a classic paper is cited when it is old. A well-known established author is more frequently cited than a new researcher in the field. The number of citations is influenced by the number of people interested in a field and the number of people who have previously published in the field. Specific reasons for citations are as follows (Weinstock 1971)

- Paying homage to pioneers;
- Giving credit for related work;
- Identifying methodology, equipment etc.;
- Providing background reading;
- Correcting one’s own work;
- Correcting the work of others;
- Criticizing previous work;
- Substantiating claims;
- Alerting researchers to forthcoming work;
- Providing leads to poorly disseminated, poorly indexed, or uncited work;
- Authenticating data and classes of fact – physical constants etc.;
- Identifying original publications in which the idea or concept was discussed;
- Identifying original publications or other work describing an eponymous concept or term;
- Disclaiming work or ideas of others; and
- Disputing priority claims of others.

7.8. BIBLIOGRAPHIC COUPLING

Bibliographic citations in scientific papers have been used by a variety of researchers to establish relationships among documents. Two important measures based on this concept which have received considerable attention in the literature are bibliographic coupling suggested by (Kessler 1963) and co-citation suggested by (Small 1973). Bibliographic coupling deals with sharing of one or more references by two documents. Two citing documents are said to be bibliographically coupled if they cite the same publication(s). The strength of the coupling between citing documents
depends upon the total number of citations that they have in common. If the number of common references is one, then the coupling strength is one. If there are two common references, then the coupling strength is two. In other words, the more the number of common references, the more the coupling strength of the papers. For example, let us consider two documents I and II. Document I cites documents A, B, C, and D; and document II cites C, D, E, and F. Hence, documents I and II are bibliographically coupled; because they both side C and D, and the coupling strength is two. Bibliographic coupling is a fixed and permanent relation and does not change with time.

7.9. CO-CITATION

It is the frequency with which two items of earlier literature are cited together by the later literature. The number of times that papers are cited together by a new or later document gives the strength of co-citation. The more the frequency of occurrence together, the stronger the relationship between the two. Co-citation patterns change as the interests and intellectual patterns of the field change with time. Co-citation can be used to map out in detail the relationship between key ideas. It can also be used to depict a literature speciality core or cluster. Co-citation provides a tool for monitoring the development of scientific fields, and for assessing the degree of the interrelationship among specialities. Co-citation helps in locating a network of frequently cited papers. Co-citation patterns are found to differ significantly from bibliographic coupling patterns. Like document co-citations, these can also be developed for authors and journals.

7.10. APPLICATIONS

Citation analysis has a number of applications. These have been described below.

a) Finding out relative use of different types of documents: Citation analysis can be used to identify the relative use of different kinds of documents such as books, periodicals, technical reports, conference proceedings, theses etc. For instance, in several of the studies reported in the literature, it has been observed that citations to articles in journals constitute a major proportion of total cited items among all types of literature sources. Similarly, one can also analyze and identify the language of the cited papers.

b) To trace the historical development of a field: Citation studies have been used for creating historical descriptions for scientific fields. By employing a network of scholarly communications one can establish the history of the field.

c) To guide a reader: Each citation is a message from the author of a document to his readers. By reading the cited document, the reader can obtain more information on a point or check the authenticity of a particular view, finding or method etc.

d) For a compilation of reading lists or bibliographies: Citations are an excellent tool for the compilation of reading lists or bibliographies, especially in an emerging field of knowledge or in subjects where areas are not clearly demarcated and the literature is scattered. In such fields, perhaps citations are the only source of information which may be of help for compiling reading lists or bibliographies. The quality of such a list would be excellent as references provided in it have been evaluated by the researchers, who are experts in the discipline.

e) For preparing a ranked list of journals: Based on the assumption that citations are indicative of the literature use patterns, these provide a methodology to rank scientific journals according to their relative degree of importance. Librarians are using it as an authentic tool for streamlining their serials acquisition policy by adding and discarding the most and less cited journals respectively. It also helps the librarian in other aspects of library management like binding policy and locating the most used periodicals in a place convenient to the readers.

f) Finding useful life of documents: Material acquired in the library becomes out-of-date with the passage of time. This is known as obsolescence of the published material i.e. slow reduction in the use of the published material. Analysis of citations by age of the cited documents can indicate the useful life of documents especially earlier volumes of periodicals.

This is based on the assumption that a document would be cited if it is used. Thus, citation analysis can be used to decide the obsolescence rate of documents in different subjects.

g) Finding out relatedness and interdependence of subjects: Citation analysis can act as an important tool in establishing important clues about the relatedness and interdependence of one field on another field by identifying how the journals of one field cite the journals of other fields.

h) To study the scatter of literature: Citation analysis helps in identifying how the literature of one discipline is scattered in the journals of other disciplines. How often the literature related to technology or applied science cite the literature of basic sciences or vice-versa? The technique can also be used to identify the countries and impact factors of journals which are being cited in the literature.

i) Citation analysis as a tool in research evaluation: Citation analysis is an important tool in evaluative bibliometrics. Citation counts may be used directly as a measure of utilization or influence of a single publication or all publications of an individual, a grant contract, department, university, funding agency, or country. This is based on a comparison of citation counts of one research group to the number of citations received by similar documents by the other research group. It is then assumed that the document with higher relative numbers of citation counts has more impact than those with lower citation counts. During the last two decades, several studies have been published in the international journal Scientometrics on the citation analysis of scientific research institutions, research groups and individual scientists.

7.11. LIMITATIONS

Citation analysis has been criticized on certain grounds. Some researchers point out that all the references appended by the author in the paper might have not been consulted by him. He has cited these references from another paper on a similar subject. This makes citation data unreliable to some extent. Another pitfall of citation counting arises due to negative citations. Authors of scientific papers often cite papers of others with a view to contradicting claims, or findings of their predecessors because of incorrect results drawn by them in their publications. These citations have a negative value and thus should get negative weight instead of positive weight in citation analysis. Also, methodological papers are among highly cited papers.

7.12. SUMMARY

Citation analysis is the hot area of bibliometric research and it received a considerable stimulus with the evolution of the Science Citation Index (SCI). Citation analysis involves counting the number of citations to a particular paper for a period of years after its publication. It can provide valuable information about the existing and emerging knowledge on a subject and the influence of the research output of a country on world science. Citation counts help a research administrator to assess the impact of the research output of each individual scientist of the organization as well as the organization as a whole. It helps to identify those earlier researchers whose concepts, methods, apparatus, etc. were used by the authors in the preparation of his article. Citations are very field dependent and the number of citations per paper varies from one discipline to another. Review journals have relatively higher citation rates. Authors of highly cited papers constitute the elite or leading scientists of the speciality.

Based on the nature of who is the citer, citations have been classified as self-citations, co-operational citations and independent citations. On the basis of citation context analysis these are classified as conceptual vs. operational (theory vs. method) organic vs. perfunctory (essential vs. non-essential), evolutionary vs. juxtapositional (development of idea vs. contrasting idea) and confirmative vs. negational (supports findings vs. opposes findings). Besides scientific merit, various other factors influence the choice of references an author cites. Two important concepts that have been developed on the basis of citation analysis are bibliographic coupling and co-citation. Citation analysis has extensively been used to find out the relative use of different types of documents, the historical development of a field, for compilation of reading lists or bibliographies, preparing the ranked list of journals, studying obsolescence of literature, relatedness and interdependence of subjects, scatter of literature and most widely in research evaluation.

7.13. MCQ QUESTIONS

1. Expand IOI A. Integrated Online Indicators B. Integrated Offline Indicators C. Internet Online Indicators D. Interface Or Internet

2. The number of citations per paper varies from one discipline to _____________

3. The number of years for which the citations are counted is known as the ___________

4. Two citing documents are said to be __________if they cite the same publication(s)

5. Eugene Garfield is associated with the development of ______________

6. Citation analysis can be used to study A. the influence of the research output B. the output of a country C. collaborative links between two countries

7. A paper published in an obscure journal, or publication with a small readership usually has A. high citation rate B. low citation rate C. no citation

8. Review journals have relatively A. no citation B. low citation rate C. higher citation rate

9. Papers more than 5 years old papers are cited A. less frequently B. more frequently C. not at all

10. Citations are __________

11. Frequency with which two items of earlier literature are cited together by the later literature is called A. Bibliographic coupling B. Co-citation

12. Citation analysis presents a connection between cited and citing documents. True/False

13. Citation analysis is not helpful in identifying earlier research papers. True/False

14. Citation data can be obtained from Chemical Abstracts. True/False

15. A relation exists between cited and citing the author. True/False

16. Scopus is the product of Elsevier. True/False

17. Giving reference to one's own previous works ___________________

18. A cross-country citation measure that compares the actual citations received by __________ from a particular country. A. Citations received from one country to another Country B. Citations received between two countries C. A bibliographic Coupling D. Actual citations received by papers from a particular country to the expected number of citations

19. Science Citation Index is a product of ____________

20. What is the name of the Science Citation Index in electronic form? A. PubMed B. ProQuest C. Citation Index D. Web of Science

7.17. SHORT QUESTIONS

What is a co-citation network analysis?

What is bibliographic coupling in the VOS viewer tool?

What are the types of citations?

What is the self-citation of the author?

LONG QUESTIONS

Describe the citation analysis and its merits and limitations.

Explain Citation Analysis. How do you relate bibliographic coupling with co-citation?

KEYWORDS: Citation; Co-citation; bibliographic coupling; Self-citation

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UNIT 8
SCIENCE INDICATORS

8.0.0OBJECTIVES

The students after reading this module and doing the exercise should obtain a basic understanding of indicators in general and S&T indicators in particular. They would also be able to apply indicators for measuring some facets of scientific activity.

8.1. OUTCOME OF LEARNING

At the end of this unit, you have gained knowledge related to various indicators and their merits; you have also learned -- how to compute. How to interpret it? What are the various limitations of various indicators? Etc. You have now learnt an important chapter in scientometrics; this will be very useful in carrying out research projects in the area of National mapping of Science.

8.2. STRUCTURE OF UNIT

- Introduction
- Science and Technology Indicators
- Input Indicators
- What is Scientometrics?
- Scientometric Techniques
- Science and Technology Performance Indicators
- Identifying Conceptual Connections among Documents
- Co-Citation Analysis
- Similarity through identifying jointly cited papers (Co-Citation)
- Co-word Analysis
- Methodological problems of bibliometric-based indicator
- Summary
- References

8.3. INTRODUCTION

Indicators are used to measure the various Dimensions that are perceived to constitute a Construct. Thus, there are two important concepts namely dimension and construct that require understanding. Constructs can be thought of as entities that cannot be directly measurable. For example creativity, performance, and intelligence are constructs. They differ from variables such as weight, blood pressure, and temperature that can be measured on a scale. Construct is thus not a single measurable entity but can be expressed through the measurement of directly observable variables. Constructs are composed of various dimensions. For example, financial indicators can show the health of a country's economy. Science and Technology indicators help to capture various facets/characteristics of science and technology such as productivity, collaboration, and impact.

An indicator should convey information about a particular element or a sub-element that it represents. Indicators are based on statistics covering various aspects of the phenomena. An ideal indicator should be representative — it should cover the most important aspects of the elements concerned. It should be reliable — in that, it should directly reflect how far the objective concerned is met, well-founded, accurate, measured in a standardized way; and feasible — data should be readily available, and at a reasonable cost.

The construction of proper indicators is dependent on Reliability and Validity. Reliability implies consistency of measurement i.e. an indicator is reliable if different people who use them get consistent results. Validity is concerned with the accuracy of the measurement i.e. indicators should be able to measure what they are intended to measure. How appropriately do proxies measure the various parameters to provide validity to the indicators? For example, indicators constructed from research papers are commonly used as a proxy for measuring scientific activity. There is a strong rationale for the choice of indicators based on research papers as a proxy. However, research papers will not generally be published in areas of strategic/military research and where research has potential for commercial exploitation. In those cases, research papers would not be a proper proxy for measuring scientific activity. The database one is using to capture the research activity in a field should systematically cover all the important journals in that field. This ensures that data for the research field is reliable. Important steps for measuring the construct through indicators: Subdivide the construct according to several sets of dimensions. Create indicators for measuring each of the dimensions. Create the composite indicator that captures all the dimensions. This composite indicator is the construct. Each dimension in itself reveals important aspects of phenomena and thus in many cases, we are interested to measure the dimension only.

8.4. SCIENCE AND TECHNOLOGY INDICATORS

Science and Technology indicators help to capture various facets/characteristics of science and technology. Ideally, they should describe the science and technology system, enabling a better understanding of its structure, the impact of policies and programs on it, and of the impact of science and technology on society and the economy. Science and Technology indicators are constructed from various input and output statistics of the S&T system. Input indicators are mainly constructed from financial statistics such as the level of funding for R&D, and funding for basic or applied sciences. A common input S&T indicator is GERD (Gross domestic expenditure in R&D). This is the total expenditure in R&D of a country with respect to the overall expenditure. Another important input indicator is constructed from Manpower involved in R&D. Indicators constructed from research papers, patents, standards, significant innovations, and product announcements are output indicators. They provide an indication of the output and outcome of the S&T.

Table 1: Common Indicators of R&D and Innovation: Strengths and Weaknesses

Measure	**Strengths**	**Weaknesses**
Financial Indicator	Helps capture how much investment is made in R&D overall by a country w.r.t. to the country's total investment.	Difficulty in identifying investment in S&T by source and by the performer. Possibility of double counting
Level of funding in R&D activity	Captures investment discipline-wise, identifies priority areas.	
Manpower Indicator	Captures S&T personnel involved in S&T overall/in different activities.	Difficult to capture the whole population involved. Overestimation and under-estimation of manpower involved in different S&T activities such as teaching, and R&D can happen.

Research Papers	A good proxy to assess scientific research.	Tacit and strategic knowledge not captured
Patents	Regular detailed & long-term data	Uneven propensity to patent across sectors, Long complex documents.
Standards	Adoption indication	Standard document in any area is scattered. Difficult to properly interpret due to technical complexity.
Significant	Direct measure of output	High cost of collecting the data. Difficult to delineate whether it is a significant innovation.
Innovations		Misses incremental changes.
Innovation Surveys	Direct measure of output	What constitutes innovation can itself be questioned.
	Comprehensive coverage	The cost of collecting data is high. Data can suffer from reliability and validity.
Expert Judgments	Direct use of expertise	Finding independent expertise.
		Judgments beyond expertise.
Product	Close to commercialization	Misses In-house process innovations.
Announcements		Misses incremental product improvements.

Financial and manpower indicators are input indicators of S&T. Indicators constructed from research papers, patents, standards, significant innovations, and product announcements are output indicators. Innovation surveys and expert surveys can capture both the input and output indications of the S&T system. Survey has data of quantitative and qualitative types. Expert has data types of qualitative types.

8.5. INPUT INDICATORS

Financial indicators help to capture the 'priority' of a country or units (firms, universities) to research. GERD is frequently used as an input financial indicator. GERD shows the investment in R&D of a country w.r.t. the total investment. S&T investment per capita is another indicator frequently employed to highlight S&T's priority. For countries with huge populations mainly India and China this indicator will give dismal indications and may not show the real aspect one wishes to measure. The share of R&D investment in different disciplines/areas of activities; investment in basic, applied research and experimental development is used to capture the research priorities of a country. Manpower indicator: Total S&T personnel of a country is applied as an indication of the scientific capacity of a country. S&T personnel by their level of education further distinguishes the knowledge pool a country has. A sophisticated indicator like FTE (Full-time equivalent) is used for showing the actual involvement of persons in R&D activities. For example, those who are involved in teaching and research through this indicator weightage is given to distinguish actual involvement in research. Say a university faculty is involved 60% of the time in teaching and 40% in research. Thus, the FTE of that person is 0.4. So, the manpower involved in the R&D of a country or unit (Say University, firm) can be properly captured through this indicator. One can also obtain the indication of the demand for S&T manpower; S&T Utilisation Ratio which indicates how many S&T personnel are involved in a country or units w.r.t to the total population, salary of R&D personal w.r.t. personals involved in other activities.

8.6. WHAT IS SCIENTOMETRICS?

The quantitative approach to characterize scientific activity emerged as a new strand of research within science and technology studies in the 1960s. Science becoming huge in terms of investment and skilled manpower requirement, competition for funding among different disciplines, and peer review process being questioned as subjective helped push the new agenda of quantitative approach. This quantitative approach to measuring scientific activity was coined Scientometrics. It is a generic term for a system of knowledge that endeavours to study the scientific and technological) the system, using a variety of quantitative approaches within the area of Science and Technology Studies (STS).

Scientometrics has followed the trajectory of econometrics in the use of quantitative data, concepts and models and extensive use of mathematical and statistical techniques for modelling and data analysis. Thus like economics which attempts to measure the 'health of economy', scientometrics attempts to measure the 'health of scientific and technological activity of the country, S&T institutions and S&T human resource'. Within this quantitative approach of 'Scientometrics', a research community became very active and was largely concerned with measuring the communication process of science. This research activity is called 'bibliometrics' and largely overlaps with scientometrics and commonly one finds they are used interchangeably. Scientometrics includes both the input and output indicators whereas bibliometrics measures the output of scientific and technology activity. Bibliometrics, especially evaluative bibliometrics, uses counts of publications, patents, citations and other potentially informative items to develop science and technology performance indicators. There are implicit assumptions/propositions that underlay the utilizations and validity of the bibliometric analysis.

- One of them is Activity Measurement which proposes that counts of patents and papers provide valid indicators of R&D activity in the subject areas of those patents and papers, and at the institutions from which they originate.
- The Second important proposition is Impact Measurement, in which it is proposed that the number of times those patents and papers are cited in subsequent patents or papers provides valid indicators of the impact or importance of the cited patents and papers.
- The Third important proposition is Linkage Measurement. In this, it is proposed that citations from papers to papers, from patents to patents, and from patents to papers,

provide indicators of intellectual linkages among the organisations that are producing the patents and papers, and knowledge linkages among subject areas.

The application of Bibliometric Analysis can be under four levels: (a) Evaluation of National or Regional technical performance (policy level); (b) Evaluation of Scientific Performance of universities or technological performance of the company (strategic level); (c) Tracing and Tracking R&D Activity in specific scientific and technological areas or problems (tactic level); science-technology linkage, etc. and (d) Identifying specific activities and specific people engaged in R&D (conventional level). Elements, units and levels of Aggregation in Bibliometrics: Bibliometric Analysis is based on publications and authors; units are specific aggregates such as journals, subject categories, and institutions and countries to which papers can be assigned. References (citations) are specific elementary links between papers. When dealing with patents, inventors and assignees are relevant elements The distinction between three levels of aggregation is important. Each level of aggregation requires its own methodological and technological approach. Micro Level: Research output of individuals and research groups; Meso Level: Research output of institutions and scientific journals; Macro level: Research output of regions and countries.

8.7. SCIENTOMETRIC TECHNIQUES

In terms of methodology, Scientometric Techniques can be classified into two categories: One-Dimensional (or scalar) and Two-Dimensional (or relational technique). One-dimensional techniques are based on direct counts (or occurrences) and graphical representation of specific bibliometric entities (e.g., publications and patents) or particular data elements in these items, such as citations, keywords or addresses. They are used to generate scalar indicators for monitoring the S&T system. Two- Dimensional Techniques are based on co-occurrences of specific data elements, such as co-occurrences of keywords/ classification codes, and authors publishing together. The two-dimensional techniques allow for capturing the network effect, and relationship among entities and play an important role in understanding the thematic structure of a research field, collaboration and its impact, and institutional linkages.

8.8. SCIENCE AND TECHNOLOGY PERFORMANCE INDICATORS

There are three types of matrices involved in publication-based indicators:

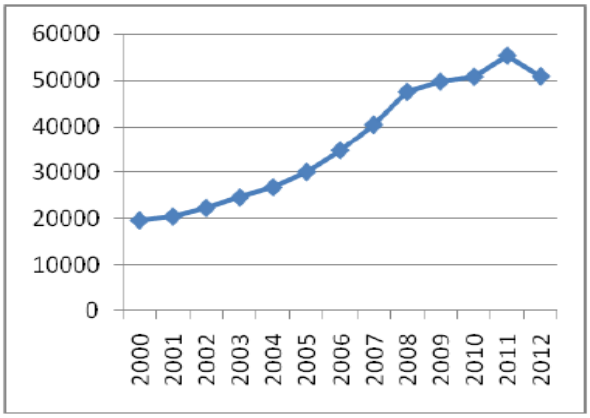
- Publication Output Matrices: Scholarly Output, Publication Share, Publication in Top percentiles (say in Top 1% of world publication, Top 10% of world publications…), Publication in Top Journal Percentiles (top journal percentiles in terms of Impact factor);
- Citation Impact Matrices: Citation count, citation per publication, Impact factor, h index, citation share; and
- Linkage Matrices: Co-Authorship, Cross-country collaboration, Co-word Matrix.

Some Common Publication Based Indicators of Productivity are highlighted in the Table below.

Table 2: Science and technology performance indicators

Indicator	Further Description	Advantage	Disadvantage
Numbers of papers	Based on the volume of paper produced by a country, institution, individual researchers	Easy to retrieve Gives a broad assessment of research activity	Does not inform about impact
Share of the number of papers	Share = (Papers from X ÷ Global output) × 100) (can also show share of different institutions in the overall publication profile of a country, research groups)	Can be useful to get relative assessment	Does not inform about impact
Comparison of research output over the years	International comparison of countries by "the degree of contribution to the production of papers in the world"	Evolution of research output in different years	Does not inform about impact
Activity in different fields	Can show the intensity of scientific activity field-wise/sub-field wise	Can be useful to see which areas are performing better if taken relative to a country/institution	Does not inform about impact
Co-authorship analysis	International collaboration/ National collaboration/ Department collaboration	Shows to what extent an unit cooperates with other units in the production of papers	Does not inform about impact

Example 1: Scientific publications and global share of scientific publications from India



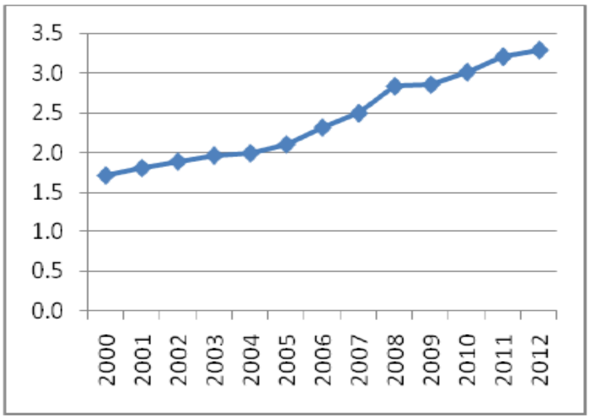


Fig. 1 a) Publication output year-wise **Fig. 1 b) Publication share year-wise**

Example 2: Share of world research output by developed countries and some emerging economies.

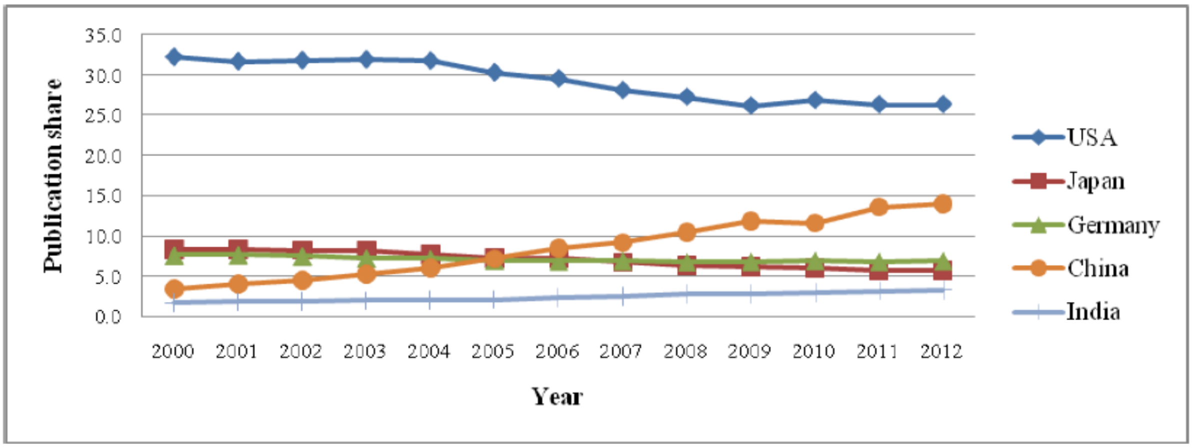


Fig. 2: Publications from India in different fields

Example 3: Publications from India in different fields.

Table 3: Research Areas

Research Areas	2000-11	
	Papers	Share
Engineering	2424670	24.3
Chemistry	1621156	16.2
Physics	1604621	16.1
Computer Science	1274468	12.8
Materials Science	973841	9.7
Biochemistry Molecular Biology	916902	9.2

Table 4: Authorship pattern of Indian publication activity in nanotechnology

Year	Single Author(Share of Publications)	Two Authors(Share of Publications)	Multi Authors(Share of Publications)
2000	13(5)	60(24)	173(70)
2005	51(4)	225(20)	846(75)
2009	103(3)	718(21)	2634(76)

Example 4: Authorship pattern of Indian publication activity in nanotechnology

Calculating Multi-authorship share of publications– Count the number of articles published by the analysed unit during the analysed time span and check how many of them were co-authored together with a selected other unit. Divide the second figure by the first one to get the share of articles co-authored between the units.

Px = Px/ P * 100

where Px = number of publications co-authored with the selected unit; P = total number of publications produced at the analyzed unit during the analyzed time. For example in the above table, the total publications P is 246 (sum of single-author publications, two-author publications and multi-author publications). The multi-author publications Px (M) as given is 173; the percentage share of multi-authors is therefore

(173/246) * 100 = 70 % (rounded value)
Some Common Publication Based Indicators of Impact.

Table 5: Publications from India: Nanotechnology Scenario

Year	Publications	Citations	Citation per paper (in the year of publication)	Citations received in the year of publication (Uncited papers in the year of publication; % Uncited)	Uncited papers (% uncited)*
2005	1072	15985	14.9 (0.3)	295 [777; 72%]	127 (12%)
2009	3086	14559	4.7 (0.4)	1364 [1869;61%]	762 (25%)
2011	5020	5260	1.0 (0.4)	2241 [3806;76%]	2674 (53%)

Example 5: Publications from India: Nanotechnology Scenario

Table 6: Trends in Highly Cited Papers (2011)

Country	Total Papers (rank)	Top 1% highly cited papers (rank)
USA	455541 (1)	9308 (1)
Japan	98890 (5)	1098 (9)
Germany	118598 (3)	2626 (2)
UK	102754 (4)	2551 (3)
France	82293 (6)	1555 (5)
China	235639 (2)	1943 (4)
India	55389 (10)	319 (20)
S. Korea	53601 (11)	533 (15)

Note: In this example, the top 1% of highly cited papers in the year 2011 globally are taken and the presence of different countries is shown by the number of papers and their rank relatively.

Table 7: Science indicator advantages and disadvantages

Indicator	Further Description	Advantage	Disadvantage
Number of citations		Indication of a papers influence	Does not take into account that older articles usually are more cited.
			Also does not take into account that the citation rates vary between document types and subject areas
Citations per publication (CPP)	CPP= Total citations received/Total papers	Gives an indication of the average scientific impact	Citation rates vary between document types and subject areas
Citations received in the	How fast paper made impact on	Show influence of the work	Areas which are topical or addressing current

year of publication	international community		debate have high probability of attracting immediate citations than others
Uncited papers	The number of papers which did not received citation even once during the time period considered	Can indicate paper is not an influential work	It can be possible that the idea is extremely novel or there are few researchers working in the subfield/topic
Highly cited papers a.	Number of papers that received maximum citations during the research period	Indicate paper of high value	High normalized citation score can be due to few highly-cited articles---this is not considered
Journal Impact Factor (IF)b	IF= Number of citations in year in a journal Divided by number of source items in the journal in the preceding two years.	It is assumed that high IF journals have high influence and more valuable. Thus papers in high IF journals are considered valuable.	IF is field dependent because citations have strong variance field-wise.
	Helps to rank journals.		Also papers in a journal are highly skewed in citation impact (how many citations they attract) and thus IF of a journal does not truly represent paper impact in that journal.
Number of papers in top ranked journals	Select journals according to a suitable criterion like Impact factor of the journal	Does reflect the potential impact of paper	Does not take the size of the analyzed time duration into account

Note: For further clarity refer to Example 6; For further clarity refer to Example 7
Some examples to qualify the above-mentioned indicators are:

Example 7: Journal Impact Factor

The 2005 impact factor of the journal Nature is produced by counting the number of citable publications in Nature during 2005 that cite publications in Nature from 2003-2004 and dividing this by the total number of publications in Nature 2003- 2004.
Description:
where: I = the impact factor for journal J in year Y; C = the number of citations from publications in year Y to publications in journal J published Y-2 and Y-1; P = total number of citable publications in journal J in year Y-2 and Y-1.

Table 8: Publication activity in some high IF Journals in different Disciplines (The year 2012)

Sl. No.	Journal (Impact Factor)	Total no. of publications	Share of Intl collaboration (%age of papers through intl. collaboration)
1	Lancet (39.060)	43	25 (58%)
2	Nature (38.597)	20	13 (65%)
3	Nature reviews molecular cell biology (37.162)	0	0
4	Nature Nanotechnology (31.170)	3	2 (67%)
5	Science (31.027)	13	7 (54%)
6	Progress in polymer science (26.383)	2	1 (50%)
7	Progress in energy and combustion science (15.089)	2	1 (50%)
8	Biomaterials (7.604)	25	9 (36%)
9	Water Research (4)	4	1 (25%)

Example 8: Publication activity in some high IF Journals in different Disciplines (The year 2012)

The Table highlights India's publication in high IF journals are driven to a large extent by international collaboration.

8.9. IDENTIFYING CONCEPTUAL CONNECTIONS AMONG DOCUMENTS

Indicators of conceptual linkages among papers can be constructed through the matrix of co-occurrences of bibliographic units. Co-occurrence among keywords and relationship among documents based on common citations are two frequently employed methods. These indications help to show the intellectual structure of a field, research fronts and analysis undertaken over a period of time show how the intellectual domain of a field is changing. Bibliographic coupling, co-citation analysis, and co-word analysis are common methods to capture these indications. Similarity through Matching Reference (Bibliographic Coupling): A reference in an article reflects one or more concepts upon which the article draws. Two articles that share a common reference (bibliographic coupling) would therefore have some linkage through the shared concept(s), even though the articles themselves might have vastly different terminology. So, searching for linkages among two or more articles through shared references offers a way to identify linking mechanisms.

8.10. CO-CITATION ANALYSIS

Similarity through identifying jointly cited papers (Co-Citation)

Co-citation analysis involves tracking pairs of papers that are cited together in the source articles. When the same pairs of papers are co-cited with other papers by many authors, clusters of research begin to form. The co-cited or "core" papers in these clusters tend to share some common theme, theoretical or methodological or both.

Method: References in a document are identified. Relatedness between these references is calculated (how many times two references occurred in the same document). The references are clustered using a co-occurrence matrix. Finally, the original documents are assigned to these reference clusters

8.11. CO-WORD ANALYSIS

Co-word analysis is a content analysis technique that uses patterns of co-occurrence of pairs of items (i.e., words or noun phrases) in texts to identify the relationships between ideas within the subject areas presented in the texts. It is used to identify the relationships between ideas within the subject areas presented in the texts and the strength of relationships between items. Co-word analysis is also very much similar to co-citation analysis. The only difference is that co-word analysis focuses on words in the document rather than references.

Method: The words or phrases that are important are identified and the relatedness between words is calculated (based on co-occurrence). Finally, the words are clustered and documents are assigned to these word clusters.
What all can be done from Publication analysis: Summary Table.

Table 9: Adopted from Tefko Saracevic study (from Rutgers University)

Origin	Rates of production, size, growth by country, institution, language, subject; Correlation with economic & other indicators
Sources	Journals: Growth, dynamics, numbers; life cycles; quantity/yield distribution; Various distributions by subject, language, country
Contents	Analysis of texts -- distribution of words, phrases in various parts; subject analysis, co-word analysis
Citations	Citation indexes, impact factors, co-citation studies etc; Some other analysis - number of references in articles, number of citations to articles, bibliographic coupling; co-citations - author connections, subject structure, networks, maps etc; papers validation with qualitative methods and impact

8.12. METHODOLOGICAL PROBLEMS OF BIBLIOMETRIC-BASED INDICATOR

Many of the problems in the construction of bibliometric indicators can be addressed if one has an understanding of the principles behind the construction of indicators. Most of the indicators often have little relationship with what they Attempt to Measure. How those measurements might be carried out and used? How do the instruments that they identify influence the working of the system? In the context of publication-based indicators following limitations are primarily visible: Indicates the quantity of output, not quality; Non-journal methods of communication are ignored; Publication practices vary across fields, journals, and employing institutions; Choice of the suitable, inclusive database is problematical; Undesirable publishing practices (artificially inflated number of co-authors; shorter papers); Papers represent only one output of the laboratory-based activity.

Citation is used as a proxy of quality but this has its own shortcomings. In particular, the fact that a paper is less frequently cited or (still) unquoted several years after its publication gives information about its reception by colleagues but to what extent it indicates quality is questionable. A paper of high value may not attract citations due to a variety of reasons. On the other hand, a questionable paper may attract high citations due to the large number of authors questioning the results. Citations vary across fields and the size of the research community among others. Lack of citation may also be due to content getting integrated into the body of knowledge of the respective subject field. Low/no citations may indicate likely that the results involved do not contribute essentially to the contemporary scientific paradigm system of the subject field in question.

The intellectual link between citing the source and reference article may not always exist; Incorrect work can be highly cited; Methodological papers are among the most highly cited; Citations are lost in automated searches due to spelling differences and inconsistencies;

Similar to publication practices, citations vary across fields, journals, employing institutions; SCI and Scopus source in which citations are available changes over time; SCI and Scopus is biased over English language journals; Works of great importance rapidly become part of common knowledge and are thus referred to in the literature without citation.

Citations may be critical rather than positive, however, it has been argued that even contested results make a contribution to knowledge; The various scientific fields are cultivated by groups of varying size, and thus the probability of being cited varies from sector to sector; The number of citations does not follow a linear rate in the course of time; The value of scientific work is not always acknowledged by contemporaries.

8.13. SUMMARY

This unit is designed to expose the students to the concept of indicators, the different science and technology indicators and their application. The main focus is on output indicators of S&T. The unit shows how scientometrics/bibliometrics helps to construct S&T output indicators and apply them for capturing the different facets of S&T activity including performance. Examples are given for highlighting the usage of some S&T indicators. It is important to construct indicators that can address the intersection of Input and Output indicators; for example, linking funding to performance indicators. Understanding the limitations of indicators based on publication and citation count can help in the proper interpretation of results. This leads to wider acceptance of indicators. The tendency to make claims that are questionable should be avoided.

8.14. MCQ QUESTIONS

1. Reliability and validity are important requirements of A. Financial Indicators B. Health Indicators C. S&T Indicators D. All types of indicators

2. Citation-based indicators cannot identify A. Productivity of a research unit B. Influence of a research group C. Intellectual linkages in a research area D. Impact of an author’s work

3. A publication-based indicator is not representative of research activity in A. An emerging research field B. A strategic research area C. Areas of theoretical research D. Areas of applied research

4. Indicators are constructed for measuring phenomena which are not directly measurable. True

5. Research papers are proxies for measuring scientific activity. True/False

6. Financial and manpower indicators are output indicators of S&T. True/False

7. Scientometrics is the qualitative approach to measuring scientific activity. True/False

8. Bibliometrics measures the output of the scientific and technological activity. True/False

9. The two major bibliographic databases used in bibliometrics are Wos (Web of Science) and Scopus. True/False

10. Number of Indication of a ___________

11. Highly Cited Papers _______________

12. Number of papers in _______________

13. Uncited papers ___________

14. Patent is granted if A. It satisfies the novelty of invention B. It satisfies that the invention is not-obvious C. It satisfies novelty and is not obvious D. Novelty, non-obvious and utility clause

15. Citation-based indicators cannot identify A. Productivity of a research unit B. Influence of a research group C. Intellectual linkages in a research area D. Impact of an author's work

16. A publication-based indicator is not representative of research activity in A. An emerging research field B. A strategic research area C. Areas of theoretical research D. Areas of applied research

17. Expand IOI A. Integrated Online Indicators B. Integrated Offline Indicators C. Internet Online Indicators D. Interface Or Internet

18. Which measurement method can be used to describe a library's collecting activity levels and goals. A. Collection depth indicators B. Qualitative Measures C. Quantitative Measures D. Both b and c

19. Data field consists of Indicators, subfields and ______________

20. Activity index does not take into consideration the size of the speciality as well as the size of the nation. False/False

8.15. SHORT QUESTIONS

What is Scientometrics?

What is the difference between citation and reference?

what is co-word analysis?

Which databases tools can be used to find and calculate bibliometric indicators?

What is the impact factor of Web of Science?

8.16. LONG QUESTIONS

What is a scientometric technique?

How do you identify a conceptual framework in an article?

What are co-citation and bibliographic coupling?

What are bibliometric indicators?

KEYWORDS: Citation; Co-word; bibliographic coupling; Self-citation

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UNIT 9
NATIONAL MAPPING OF SCIENCE

9.0. OBJECTIVES

- What is bibliometric mapping?
- Dimensions of bibliometric mapping;
- Different indicators for mapping;

- Methodology to be undertaken for bibliometric mapping; and
- Details of several indicators used for mapping national performance

9.1. OUTCOME OF LEARNING

To a great extent, the NMP is also an applied Scientometrics; after completion of this module, you have gained knowledge with regard to several dimensions of national mapping of science; also you have studied how to apply whatever you have learnt in the earlier seven modules to collect and analyze Scientometric data related to a country; to institutions (in a country), to journals (from a country), to authors of a country etc. Also, you have learnt the methodology to undertake national mapping of science.

9.2. STRUCTURE OF UNIT

- Introduction
- What is bibliometric mapping?
- Dimensions of science mapping
- Indicators on which mapping is based
- Methodology to be adopted for undertaking mapping
- Indicators used for computing national performance
- Illustrations
- Summary
- References

9.3. INTRODUCTION

Scientific performance is essentially a multidimensional concept, which cannot be measured by a single universal indicator. There may be a number of imperfect or 'partial' indicators, each representing a different aspect of research performance, with varying degrees of success. Nonetheless, publications in refereed scientific journals constitute the most important indicator of research performance. Careful analysis of scientific output in the form of publications can provide deep insights for making inter-institution, inter-field and international comparisons of research performance.

9.4. WHAT IS BIBLIOMETRIC MAPPING?

Bibliometric mapping of science basically deals with the quantitative analysis of scientific literature based on bibliographic data. The general aim of a bibliometric map is to provide an overview of the structure of the scientific literature within a domain or on a certain topic. A bibliometric map can be used to identify research areas within a scientific field, to get insight into the size of the different areas, and to see how the areas relate to each other. These are especially useful when one has to deal with a relatively large body of literature and can be used in a number of different contexts. In the context of science policy and research management, bibliometric maps can be used to support decision-making by governments, funding agencies, and universities.

9.5. DIMENSIONS OF SCIENCE MAPPING

There are several dimensions of bibliometric mapping and it can be used to study different aspects of the research output like Channels of communication used for communicating research results by different nations or institutions; Cross-national assessment: How are the research efforts distributed among different nations? Is it distributed evenly or is it concentrated only among a few nations? It can also be used to study the regional distribution of scientific output in a country or assessment of different performing sectors like academic institutions or publicly funded research institutions etc.

Inter-institution comparison: How is the research effort distributed among different institutions? Which are the leading national and international institutions in the field, and what are their relative strengths and weaknesses? Inter-field comparison i.e. to assess the relative emphasis of different nations on different disciplines like physics, chemistry, mathematics, engineering etc. or sub-fields within a broad discipline; Can help in developing activity and attractively profiles of the identified nations and institutions in different fields of science and technology, based on the output in scientific journals, and to compare the two profiles; Can be used to examine the connectivity of research output of a nation to the mainstream science and its impact by examining the impact factor of journals where the research results are published and their pattern of citations; Can be used for examining the co-authorship and collaboration pattern for different nations and in different fields of science and technology; Can be helpful in identifying the most prolific and highly cited authors in science and technology as a whole or a discipline of the same; and Modeling the growth trends of world research output vis.-a-vis. of different nations under study.

9.6. INDICATORS ON WHICH MAPPING IS BASED

The mapping exercise is basically based on publication counts and their citation counts. Publications are used to measure the quantity of output, while citations are used for measuring
the impact or influence of the scientific output.

9.6.1. Publication counts

The count of publications in peer-reviewed scientific journals is the most frequent measure of scientific performance and can serve as a basic S&T activity indicator. It constitutes a key element in every evaluation and its use is widespread. The research produced by the institutions of a country, to a great extent, reflects the governmental science policy as well as national interests and priorities. Counting of scientific publication output is the most basic technique of Scientometrics, in which the number of publications by an individual, an institution, a country or a group of countries like ASEAN, SAARC, OECD, EEC etc. is aggregated. By making use of publication counts it has been possible to point out the scientific centres, sub-centres and peripheries of world science. It can be helpful in finding out the outstanding scientist available in a country in a field.

Scientific output in the form of publications has been used to study the pattern of co-authorship and collaborations. Productivity data in the case of a country can be used to build up science city maps of a country. Such information would help science planners to strengthen those cities that need specific augmentation. It can also be used to monitor the mobility of scientists as well. The mobility can be between various cities within the country as well as between two countries. Data on mobility between countries would be particularly useful for developing countries, where there is a need to establish strong links with scientifically developed nations.

Publication counts have been attacked mainly on the ground that they do not indicate the quality of work. A mere count of publications may lead to incorrect inference about the contribution an individual makes to the extension of knowledge. In view of this, scientists have started using the count of citations or surrogate measures of quality based on the impact factor of journals developed by the Institute of Scientific Information (now Thomson Reuters, USA) and available in the Journal Citation Report published every year by the Thomson Reuters as a supplementary volume to Science Citation Index. The Journal Citation Report is available on the Web.

9.6.2. Citation counts

While publication counts measure output, citation counts are considered to go one step further and address questions of impact, influence, and transfer of knowledge. Garfield suggested the technique of counting citations to individual papers in 1963. Citation counts are the basic data for bibliometric mapping exercises, and are the most active area of Scientometrics. Citation counts provide quantitative information on the visibility of the papers. The technique of citation counts rests upon the fact that scientists cite earlier publications because the work contained in them is in some way relevant to their own. The basic assumption of citation is that it reflects the influence of an article relative to others and thus the impact of scientific research. The number of citations to a publication is generally recognized as an indicator of the influence of a piece of published work on the scientific output. However, citations have their own critics. The basic criticism against citation is that all citations are not made for scholarly reasons. There are other reasons for citations besides the scholarship of the work. Other criticisms include inadequate coverage of journals by Science Citation Index Expanded, especially from Third World Countries, time lag between the date of publication and date of its citation, the cost involved, field-to-field variations and the time period required for citations to achieve their highest frequency. In spite of these inadequacies of citations, empirical evidence suggests a high correlation between citation counts and other measures of impact, such as location in a prestigious university, being listed in important biographies of scientists, and receiving scientific awards and recognition by colleagues.

9.6.3. Surrogate measures of citations

Another alternative to measuring the impact of scientific performance is to use surrogate measures of citations based on the citation frequency of the journal in which the article appears. In this procedure, instead of counting actual citations received by an article in a certain time period, the journal quality indicator weighs the article. In this procedure, the time lag due to the citation process and the cost of acquiring citation data are drastically reduced. The use of journal quality indicators is based on the assumption that all papers appearing in a journal receive approximately the same number of citations. However, the same is not true.

The most commonly used journal quality indicator is Impact Factor (IF) suggested by Garfield and is annually available in Journal Citation Report. Besides the Impact Factor, the other measures are Journal Citation Score developed by Moed[4], and Influence Weight developed by Narin. All these measures are independent of the size or periodicity of the journal as they are constructed on a per-article basis. However, these measures are not in vogue. A detailed description of the Impact Factor is available in the succeeding paragraphs under indicators used for computing national performance.

9.7. METHODOLOGY TO BE ADOPTED FOR UNDERTAKING MAPPING

Before undertaking a mapping exercise, the researcher should decide the use of a proper database that can be used for undertaking the mapping exercise and the time period for which the study is to be undertaken. The time period should not be too small like one or two years.

It should be large enough to point out trends. However, the quantum of data to be used will vary according to the choice of the countries to be compared and the period for which the study is to be made. The conventional method of undertaking a mapping exercise was to prepare index cards for each identified record containing different bibliographic information of the publication like the author(s) and their affiliation, subject studied, type of document used for publishing research results, type of collaboration, and other details of the record like country of publication of the journal, impact factor of the journals as reflected in Journal Citation Reports, and the citations received by the article. However, with the evolution of web-based databases like the Science Citation Index now Web of Science (Science Citation Index-Expanded) of Thomson Reuters and the Scopus of Elsevier, the method has changed considerably. The data for a group of nations or for an individual country or a subject can directly be downloaded from these databases, which then can be converted into a database for analysis. Several variables that need downloading may be the name of the author(s), an affiliation of the author(s), the country of the author(s), type of publications i.e. journal articles, monographs, conference proceedings, reviews, letters, type of institutions (academic, research, industrial), name of the journal with its country of publication etc. The data so downloaded is to be enriched with other information like impact factor or the normalized impact factor of journals in which the papers were published, type of collaboration, viz. local, domestic and international. After enriching the data, it is to be analyzed to meet the various objectives mentioned in the above paragraph. Subject databases like BIOSIS and PUBMED can also be used for undertaking mapping exercises. However, the publication data obtained from these is to be enriched with citation data.

9.8. INDICATORS USED FOR COMPUTING NATIONAL PERFORMANCE

Several Scientometric indicators have been suggested in the literature to measure national performance. Some of these have been described below as describing them all is beyond the scope of this chapter.

9.8.1. Activity Index

Activity Index was first proposed by Frame[6]and later elaborated by Schubert and Braun[7]. It characterizes the relative research effort a nation or an institution devotes to a given subject field or sub-field and takes into consideration the effect of the size of the country as well as the size of the sub-speciality. Activity Index (AI) is defined as follows:

AI = {(The country's share in the world's publication output in the given field)/ (The country's share
in the world's publication output in all fields)} x100
Mathematically $AI = \{(N_{ij} / N_{io}) / (N_{oj} / N_{oo})\} \times 100$
N_{ij}: number of publications of country i in a field j;
N_{io}: number of publications of country i in all fields;
N_{oj}: number of publications of all countries in field j;
N_{oo}: number of publications of all countries in all the fields.
Here `all’ implies the countries included in the study.

The value of AI=100 indicates that the research effort of a country/institution in a given field corresponds precisely to the world's average; AI >100 reflects higher than average activity and AI <100 is lower than average effort dedicated to the field. The major advantage of using activity index over a raw (absolute) count of publications is that it takes into account both the size of the nation/institution as well as the size of the discipline.

9.8.2. Attractively Index

Like the absolute publication output, the absolute impact is also confounded by the size of the country and the size of the field. Hence, Schubert and Braun[8] suggested Attractively Index to calculate the impact. Attractively Index characterizes the relative impact; the publications of a country/institution make in a given field or sub-field as reflected by the citations they attract.

Attractively Index (AAI) is defined as follows:

AAI = {(The country's share in citations attracted by publications in the given field)/ (The country's share in citations attracted by publications in all science fields)} X100

Mathematically AAI = $\{(C_{ij} / C_{io}) / (C_{oj} / C_{oo})\} \times 100$

C_{ij}: Citations of country i in field j;

C_{I0}: Citations of country i in all fields;

C_{oj}: Citations of all countries in field j;

C_{oo}: Citations of all countries in all fields.

AAI =100 indicates that country's citation impact in the given field corresponds precisely to the world's average, AAI > 100 reflects higher than average, and AAI < 100 is lower than average.

9.8.3. Impact Factor

At present, there is no better indicator applicable in practice characterizing the scientific impact of journals than the impact factor suggested by Garfield[9]. Although in Bibliometrics there are other indices as well like the influence factor suggested by Narin[10], its use has not become widespread. Garfield's impact factor has, on the other hand, became institutionalized knowledge. Garfield's impact factor "is basically a ratio of the number of citations a journal receives to the number of papers published over a period of time". Journal Citation Report gives yearly impact factors for the journal covered by Science Citation Index. The impact factor of journal X for a particular year would be calculated by dividing the number of all the citations of articles journal X received during that particular year by the articles published by journal X in the previous two years.

Mathematically Impact Factor (IF) of a journal X for the year 2011 will be calculated as follows:

I.F. journal X for 2011 = {(Number of citations received by the articles published in journal X in
the year 2011/ Number of papers published by journal X in the years 2009 and 2010)}

9.8.4. Normalized Impact Factor

The impact factor of journals varies from one field of knowledge to another field; hence, it is necessary to normalize the impact factor, when comparing the performance in different disciplines. Several authors[11] have suggested different methods to normalize the impact factor, but the method suggested by Sen[12] is simple and can be applied easily to compute the normalized impact factor of the journals. However, in this method review journals are not included while calculating the normalized impact factor as these have a high impact factor as compared to other journals.

Mathematically $(NIF)_{ij} = \{(GIF)_{ij} / Max\ (GIF)_{ij}\} \times 10$ where

NIF is the Normalized Impact Factor of journal i in sub-field j;

GIF is the Garfield’s Impact Factor of journal i in sub-field j, and;

Max (GIF) is the value of the highest impact factor in the set of journals.

9.8.5. Citation per Paper (CPP)

It is the most widely used indicator in bibliometric studies. It is a relative indicator computed as the average number of citations per publication. It normalizes the wide disparity in the volume of literature published by prolific publishing nations and other smaller nations for a meaningful comparison of research influence. It is the ratio of the total number of citations to the total number of publications. In case, where citations are not available, one can use normalized impact per paper which has been described below.

9.8.6. Normalized Impact per Paper (NIMP)

Based on the publication pattern and the normalized impact factor of the journals where the research results are published, normalized impact per paper suggested by Nagpaul[13] can be calculated. Normalized impact per paper is basically the average i.e. (Total Normalized Impact/Total number of papers).

9.8.7. Relative Citation Impact (RCI)

The indicator[14] was developed by the Institute of Scientific Information (now Thomson Reuters, USA). RCI measures both the influence and visibility of a nation's research from a global perspective. RCI is a ratio of a country's share of world citations (per cent citations) to the country's share of world publications (per cent publications). RCI = 1 indicates that country's citation rate is equal to the world citation rate; RCI > 1 indicates that country's citation rate is higher than the world's citation rate and RCI < 1 indicates that country's citation rate is less than the world's citation rate.

9.8.8. Relative Citation Rate (RCR)

The measure has been suggested by Schubert and Braun[15]. It is defined as the ratio of the actual number of citations received by a set of papers with an expected number of citations. The expected number of citations is calculated by summing the impact factors of the periodicals where the publications appeared. The value of RCR equal to 1 indicates that the paper(s) received as many citations as it was expected to get. RCR > 1 indicates that the paper(s) received more citations than expected, and RCR < 1 indicates fewer citations than expected. This indicator eliminates differences in the publication and citation practices of different subfields.

9.9.9. Number of High-Quality Papers (NHQ)

The measure has been suggested by Nagpaul[16]. For calculating a number of high-quality papers, one has to first calculate the average of the citation per paper or the average of the normalized impact factor. Based on the values of the average of citation per paper or the average normalized impact per paper, the value of the number of high-quality papers can be obtained. Those papers will be considered high-quality papers which have citation per paper or normalized impact per paper above a threshold (twice or more) than the average values of these indicators.

9.9.10. Publication Effective Index

Nagpaul[17] has also suggested this measure. This indicates whether the impact of research on a country is commensurate with its publication effort. This indicator is the ratio of the proportion of the total normalized impact (TNIMP %) to the proportion of the publications (TNP %).

9.9.11. Relative Quality Index (RQI)

This indicator is the ratio of the proportion of high-quality papers (NHQ%) to the proportion of total publications (TNP%), where NHQ % = (Number of high-quality papers for a country or an institution / Total number of high-quality papers) x 100. The measure relates to the incidence of high-quality papers in a field by a country or an institution. A value of RQI > 1 indicates higher than average quality, whereas the value of RQI < 1 indicates lower than average quality.

9.9.12. h-index

The measure was proposed by Hirsch[18]. The h-index of a scientist is [h] if [h] among his/her [N] articles have at least [h] citations each and other (i.e. remaining [N-h]) articles have fewer than h\ citations each. An h index, say, of 10 of a scientist means that among all the articles published by
the scientist have received at least 10 citations each. Besides the above-mentioned indicators, several other indicators have been suggested in the literature. However, their description is beyond the scope of this chapter.

9.10. ILLUSTRATIONS

The application of the above indicators has been demonstrated below by using suitable examples from various fields.

9.10.1. Channels used for communicating research results by different countries

In several of the studies published in the literature, it has been observed that journal articles including reviews account for the maximum number of publications. The rest of the research papers may be published in conference proceedings, letters to the editor, book chapters or books depending upon the field of study. However, some research may also be published as a technical report or a patent. For instance, in a study undertaken by Garg and Padhi[19] for international output in laser science and technology for the period May 1990 – April 1991, it was found that all countries of the world published the highest number of papers as journal articles which accounted for 74% of the world publication output in laser science and technology. Rests 26% were patents, technical reports and conference proceedings etc.

9.10.2. Cross-national assessment of research output

This has been demonstrated using global output in the field of laser science and technology for the period May 1990-April 1991. Table 1 presents the data on the publication output and activity index of different countries in different sub-specialities of laser science and technology. The total output came from 50 countries but is mainly concentrated in 14 countries listed in Table 1. From the data presented in Table 1, it is observed that like other fields of science and technology, in this field also, the USA tops the list. This is followed by Japan and the erstwhile USSR. These three countries together produced about 70% of the total output. Further analysis of the data on AI indicates that AI for the USA is almost equal for all the sub-specialities indicating that it has paid almost equal priority to theoretical, experimental and applications of laser research. As indicated by the values of AI for Japan, Germany and France, it is observed that the research effort in these countries is concentrated on applications of laser research. All other countries except UK and Switzerland have given priority to theoretical laser research, while, UK and Switzerland have given priority to experimental laser research. From this, it can be inferred that different countries emphasize different specialities in the field of laser science and technology.

Table 1: Publication output (Activity Index) of different countries in sub-specialities of Laser S&T during May 1990-April 1991

Country	B Articles (AI)		C Articles (AI)		D Articles (AI)		Total
USA	347	(100)	699	(102)	358	(96)	1,404
JPN	51	(47)	242	(112)	150	(128)	443
USSR	125	(136)	174	(96)	72	(73)	371
UKD	43	(75)	126	(112)	63	(102)	232
GERM	35	(97)	58	(82)	53	(137)	146
FRA	30	(85)	71	(103)	41	(109)	142
CAN	29	(140)	30	(73)	25	(112)	84
ITA	14	(123)	20	(89)	12	(98)	46
PRC	27	(148)	31	(89)	14	(73)	72
IND	27	(182)	21	(72)	13	(80)	61
ISR	19	(154)	16	(66)	15	(113)	50
NLD	17	(153)	17	(78)	11	(92)	45
SWT	1	(11)	27	(146)	10	(99)	38
AUS	20	(202)	14	(72)	6	(57)	40
Total	785		1,546		843		3,174

9.10.3. Attractively profile different nations in different sub-specialities

AAI helps to understand whether the field of highest activity is also the field of highest impact or not. The same has been demonstrated here using normalized impact factor in place of citations for calculating the attractive index. The datasets are the same as has been used above for calculating AI. The results of the attractive index given in Table 2 indicate that AAI for the U.S.A in all the subspecialties of laser science and technology is almost equal to the activity index. However, in the case of Japan and Italy, the values of AAI are greater for experimental laser research unlike their activity index, which is higher in the sub-speciality of applications and theoretical laser research. The attractively profile and activity profiles for USSR, France, Canada, China, India, Israel, Netherlands, Switzerland, and Australia are similar.

Table 2: Impact (Attractivity Index) of different countries in sub-specialities of laser S&T during May 1990-April 1991

Country	BImpact (AAI)		CImpact (AAI)		DImpact (AAI)		Total
USA	1178	(100)	2436	(100)	990	(102)	4604
JPN	154	(54)	708	(120)	250	(107)	1112
SUN	133	(193)	109	(77)	26	(46)	268
UKD	113	(82)	297	(105)	125	(111)	535
DEU	95	(99)	183	(92)	96	(122)	374
FRA	94	(97)	203	(100)	85	(106)	382
CAN	93	(154)	93	(74)	49	(99)	235
ITA	30	(97)	68	(107)	22	(87)	120
PRC	58	(144)	77	(94)	19	(58)	154
IND	70	(194)	45	(60)	26	(87)	141
ISR	53	(153)	50	(70)	32	(112)	135
NLD	46	(132)	72	(100)	17	(60)	135
SWZ	2	(7)	91	(146)	24	(97)	117
AUS	47	(172)	44	(78)	15	(67)	106
Total	2166		4476		1776		8418

Using similar methodology researchers can study the regional distribution of science in a country. For instance, in a study carried out by Garg and Dutt[20] on the regional distribution of Indian science using the publication data for the year 1984, it was observed that science in India is mainly concentrated in the state of Uttar Pradesh, Maharashtra, West Bengal and Delhi with almost 50% of the Indian scientific output published by these four states. Four metropolitan cities namely, Delhi, Mumbai, Kolkata, and Bangalore published more than 53% of the Indian scientific output.

9.10.4. Inter-institutional assessment of research output

Using the methodology described in the above paragraphs researchers can make an inter-institutional assessment of the research output. An analysis of the Indian research output in science and technology for the year 1997 indicates that the total Indian scientific output came from 1107 institutions located in different parts of India. Of these, 29 institutions contributed 85 or more papers and accounted for 45% of all publications. These institutes belonged to different performing sectors like academic institutions, engineering institutions, medical institutions and publicly funded research agencies like the Council of Scientific and Industrial Research (CSIR), Indian Council of Agriculture Research (ICAR), and Indian Council of Medical Research (ICMR) etc. Table 3A given below presents the data on the absolute output and activity index of the five most prolific Indian institutions in five broad disciplines and Table 3B gives data on the absolute impact and attractively index of these five institutes. Disciplines of higher AI and AAI have been marked in bold. Values of AI and AAI for IISC were highest (141) for biological sciences, while in the other two disciplines where it had higher values of AI; it had a low value of AAI. For the remaining three institutions, the values of AAI were higher for disciplines which had higher values of AI. In the case of AIIMS, AAI were also quite high in biological sciences which had a low value of AI. Also, an institution can be active in different fields and one institution can emphasize more than one field.

Table 3A: Absolute output (AI) of five prolific Indian institutions in science and technology in 1997

Institutions	Biological Sciences	Chemical sciences	Engineering Sciences	Medical Sciences	Physical Sciences	Others	Total
IISC	86(126)	96(82)	74(126)	10(11)	155(119)	126	547
BARC	14(32)	65(103)	77(208)	15(26)	131(159)	44	346
TIFR	33(93)	10(111)	6(20)	4(90)	189(280)	41	283
AIIMS	33(104)	0(0)	0(0)	216(517)	0(0)	4	254
BHU	52(173)	26(64)	29(112)	38(96)	52(91)	44	241
Others	Other 24 prolific institutions have not been shown in the Table						
Total	1383	1878	1185	1821	2635	2165	11067

Table 3A: Absolute output (AI) of five prolific Indian institutions in science and technology in 1997

Institutions	Biological Sciences	Chemical sciences	Engineering Sciences	Medical Sciences	Physical Sciences	Others	Total
IISC	222(141)	261(114)	175(115)	24(12)	349(106)	295	1326
BARC	26(28)	156(113)	179(193)	24(20)	309(156)	99	793
TIFR	105(112)	26(19)	14(15)	6(5)	566(287)	73	790
AIIMS	80(135)	0(0)	0(0)	412(541)	0(0)	7	499
BHU	88(174)	40(54)	56(112)	64(98)	99(93)	79	426
Others	Other 24 prolific institutions have not been shown in the Table						
Total	2734	3982	2691	3505	3730	4327	22969

IISC: Indian Institute of Science, BARC: Bhabha Atomic Research Centre, TIFR: Tata Institute of Fundamental Research, AIIMS: All India Institute of Medical Sciences, BHU: Banaras Hindu University.

9.10.5. Impact of research output

The most prolific institutions made up 48% of the total impact and 46% of all high-quality papers published in India. The majority of the papers published by these institutes have appeared in journals originating from the scientifically advanced countries of the West. This indicates that the research performed at these institutes evokes considerable interest among the western scientific community, and thus forms a part of mainstream science. Table 4 provides information about various impact indicators such as Normalized Impact per Paper (NIMP/paper), Publication Effective index (PEI), and Relative Quality Index (RQI). The average value of NIMP/paper for Indian publication output is 2.1. Among all the prolific institutions, TIFR had the highest value of NIMP/paper (2.8). Like the NIMP/paper, the value of PEI is also highest for TIFR closely followed by IISC. For BARC also the value of PEI is also more than 1. It implies that these institutes earn more impact than what is commensurate with their publication effort. The standing of different institutions on the basis of the incidence of high-quality papers can be judged by the value of RQI. Here, also TIFR had the highest value (3.4) followed by AIIMS. This indicates that these institutes have more than average incidence of high-quality papers and the remaining three have less than average incidence of high-quality papers.

Table 4: Impact indicators of prolific institutions in 1997

Institutions	TNP	TNIMP	NIMP/paper	NHQ	PEI	RQI
IISC	547	1326	2.4	55	1.2	1.2
BARC	346	793	2.3	19	1.1	0.7
TIFR	283	790	2.8	79	1.3	3.4
AIIMS	254	499	2.0	33	0.9	1.6
BHU	241	426	1.8	10	0.8	0.5
Others	Other 24 institutions have not been shown in the Table					
Total	11067	22969	2.1	903	1.0	1.0

9.10.6. International connectivity of the research output

International connectivity of the research output can be examined by using parameters such as papers in non-SCI journals vs. SCI indexed journals, papers in domestic journals vs. international journals, impact factor of the journals where the research results are published, and the pattern of citations of the research output. If more number of papers is published in international journals indexed by SCI with high impact factor journals, then the research output is internationally connected. The above argument is based on the fact that international journals indexed by SCI having high impact journals has wider readership probability and hence reflects higher potential connectivity compared to those appearing in domestic journals which have less circulation as compared to international journals. Similarly, if significant number of papers published by a country is cited in the international literature, then that field of study is an integral part of the mainstream science. In a study undertaken by Jain and Garg[21] in the discipline of laser science and technology, it was observed that laser science and technology performed in India were internationally connected and formed the part of the mainstream science.

9.10.7. Co-authorship and collaboration pattern

The research output can be used to study co-authorship and collaboration pattern. This has been dealt separately in chapter on scientific collaboration.

9.10.8. Modeling the growth trends of world research output vis.-a-vis. India

In a study undertaken by Jain and Garg[22] on the world and Indian scientific output in the field of laser science and technology, it was found that the pattern of growth is similar to a S-shaped curve with an initial slow growth, followed by exponential growth and finally slowing down to its saturation level. Detailed description about modeling the growth trends will be discussed in a separate chapter on modeling.

9.11. SUMMARY

Publications in the refereed scientific journals constitute the most important indicator of research performance. It can identify topics with significant increase in world publication output (hot topics); topics with significant decrease (cold topics); and topics with no significant increase or decrease in world publication output (stable topics). If a country publishes much less than the world average on a hot topic, it implies that the country has failed to pick up new developments and it needs some exploration. For stable topics, equal or above world average activity is a sign of healthy development, while a significant lower activity indicates a weakness. For cold topics, a significantly higher activity indicates that a country is putting too much effort on a topic, where scientific payoff is lean.

Publication output can provide deep insights for making inter-institution, inter -field and international comparison of research performance. Bibliometric mapping can be used to study different aspects of the research output like channels of communication used for communicating research results, cross national assessment, inter-institution comparisons and inter-field comparisons. It can also be used to identify the strong and weak areas of research within a nation, connectivity of its research output to the mainstream science and its impact using different impact indicators besides examining the co-authorship and collaboration pattern for different nations in different fields of science and technology.

The mapping exercise is basically based on publication counts and their citation counts. Publications are used to measure the quantity of output, while the citations are used for measuring the impact or influence of the scientific output. Several indicators have been suggested in literature for computing national research performance and its impact. These include Activity Index, Attractively Index, Impact Factor, Normalized Impact Factor, Citation per Paper, Normalized Impact per Paper, Relative Citation Impact, Relative Citation Rate, Number of High Quality Papers, Publication Effective Index, Relative Quality Index and h- index.

9.12. MCQ QUESTIONS

1. The measure h index was proposed by __________

2. Science Citation Index is a product of _____________

3. The data regarding impact factor is available in _________

4. Scopus is a product of ______________

5. Publications in peer reviewed scientific journals are the most frequent measure of __________

6. Bibliometric mapping is basically based on A. papers published in scientific journals B. technical reports C. book chapters

7. Number of publications is a measure of A. impact B. output C. visibility

8. Number of citations is a measure of A. output B. collaboration C. visibility

9. Impact factor is measure of A. output of a journal B. output of a country C. standing of a journal 10. Citation per paper is given by A. Number of citations/ number of papers B. Citations percent / publications percent C. (NIF) i j = {(GIF) i j / Max (GIF) i j} x 10

11. Activity index does not take into consideration the size of the specialty as well as the size of the nation. False/True

12. Citation per paper is a measure of output. False/True

13. Impact of research output of a country can be measured by citations. False/True

14. Impact Factor measures the rank of a journal in a discipline. False/True

15. Citation counts reflect the impact and visibility of a paper. False/True

16. Impact Factor is calculated for individual or group of researchers. False/True

17. Immediacy index shows the impact of an article for the past decade. False/True

18. Number of references received from other works ____________

19. A measure reflecting the average number of citations to recent articles published in the journal and intended to gauge the importance of a journal in its given field ___________

20. An indicator which measures the current importance of the work published by a journal by calculating the average number of times articles published during a particular year by a specific journal is cited over the course of that same year _____________

9.13. SHORT QUESTIONS

What is a bibliometric database?

What is bibliometric mapping?

What is science mapping?

How do you cite VOSviewer?

What is Methodology mapping?

9.14. LONG QUESTIONS

Which databases tools can be used to find and calculate bibliometric indicators?

What maps are a method by which the content of many articles is systematically analysed?

What are the indicators of national development?

KEYWORDS: Bibliometric mapping; Science mapping; Methodology mapping; Bibliometric indicators

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UNIT 10
COLLABORATIONS IN SCIENCE

10.0. OBJECTIVES

- What is collaboration?
- What are the reasons for collaboration?
- Different measures of collaboration;
- Steps involved in the calculation of different measures; and
- What can be measured with data on collaboration?

10.1. OUTCOME OF LEARNING

Collaborative research is an important area of research in Scientometrics; you have learnt this topic in this module. You are now familiar with various indices of collaborative research -- that exists among the individual scientists, institutions and among countries; it may be at the regional, national or at international levels.

10.2. STRUCTURE OF UNIT

- Introduction
- Types of collaboration
- Reasons for collaboration
- Different measures of collaboration
- Steps involved in the calculation of various measures
- What can be measured with data on collaboration?
- Summary
- References

10.3. INTRODUCTION

Science is no longer a pursuit of an individual. Collaborative research is an important feature of science. Does the question arise as to what is collaboration? In simple terms, collaboration can be defined as the working together of two or more researchers to achieve the common goal of producing new knowledge. Collaboration takes place not only in the immediate work environment of researchers, but also extends beyond institutional and national boundaries. Governments in different countries have taken initiatives to enhance contacts among scientists in science through collaborative research programs, both at the national and international levels. Such initiatives have resulted in increased collaborations at national and international levels.

Statistical data indicate that percentage of research produced by teamwork has been growing steadily for more than half acentury[1,2]. For instance, the share of papers written by authors located in two or more different institutions rose from about 33% in 1981 to 50% in 1995, while the total number of papers rose by about 20%. During the same period, the share of co-authored papers rose from about 6% to 15%.

According to Beaver and Rosen[4] collaboration resulted in response to professionalization and increased knowledge in science. During the 20th century, the professionalization of science had its greatest impact on the members of the scientific community. And because of this, there has been an increasing trend toward collaboration in almost all fields of science and technology. However, the extent of collaboration and their rate of growth vary from one subject to another, branch to branch of the same subject and from one country to another country. Among all countries involved in collaboration, the US is the major hub which accounted for 17% of all internationally collaborative papers in 2008. The major impact of collaboration on scholarly research is the increase in productivity associated with multiple authorships as well as shared resources and increased funding opportunities. Articles written in collaboration are more important than those involving no collaboration and articles written in international collaboration receive more citations than articles written in domestic collaboration, which in turn receive more citations than articles written in local collaboration. This implies that internationally co-authored articles represent a more important segment of world science.

10.4. TYPES OF COLLABORATION

Collaboration in research can take a variety of paths. Based upon the type of participants and the location etc, collaboration can be categorised into three broad categories. These are local collaboration, domestic collaboration and international collaboration. A local collaboration occurs when scientists of two departments of the same institute collaborate; a domestic collaboration takes place when scientists from two or more institutes within the country collaborate and an international collaboration occurs when institutions from two or more countries join hands together to solve a problem. Among all these types of collaborations, international collaboration has received the maximum attention. International cooperation in science is becoming more frequent and more extensive and is playing a significant role in the production of scientific knowledge. The growth in international cooperation is accompanied by the increase in the number of participating research laboratories or institutions in several countries. International cooperation in science is caused by two different mechanisms–formal and informal:

- Informal contacts among scientists from different countries like exchange of ideas through informal communication, and participation in international conferences. In some cases, this may lead to research collaboration with foreign institutions resulting in the publication of co-authored articles.
- Formal contacts like bilateral or multilateral cooperation agreements among different countries may lead to an exchange of scientists as well as the setting up of joint cooperation programmes. This type of cooperation among nations occurs to resolve global challenges or for strategic reasons. Examples of such cooperation are megaprojects like the Large Hadron Collider (Switzerland) and International Thermonuclear Experimental Reactor (France).

10.4.1. Reasons for collaboration

Beaver[7] have enumerated the following purposes for which people collaborate:

- Access to expertise.
- Access to equipment, resources, or “staff” one doesn’t have.
- Improved access to funds.
- To obtain prestige or visibility for professional advancement.
- Efficiency: multiplies hands and minds; helps to learn the tacit knowledge that goes with a technique.
- To make progress more rapidly.
- To tackle more important, more comprehensive, and more difficult problems that are global in nature.
- To enhance productivity.
- To get to know people, to create a network, like an “invisible college”.
- To learn new skills or techniques, usually to break into a new field, subfield, or problem.
- To satisfy curiosity and intellectual interest.
- To share the excitement of an area with other people.
- To find flaws more efficiently, and reduce errors and mistakes.
- To keep one more focused on research because others are counting on one to do so.
- To reduce isolation, and recharge one’s energy and excitement.
- To educate [a student, graduate student, or, oneself]
- To advance knowledge and learning.
- For fun, amusement, and pleasure.

10.5. DIFFERENT MEASURES OF COLLABORATION

To measure the extent of co-authorship or collaboration, different authors have suggested different methods for computing it. These are described in the following paragraphs.

10.5.1. Collaborative Index (CI)

The measure was suggested by Lawani and is expressed as follows:

$$\mathrm{CI} = \sum_{j=1}^{k} \frac{\mathrm{j f_j}}{\mathrm{N}}$$

Where f_j denotes the number of j-authored research papers published in a discipline in a certain period of time; N denotes the total number of research papers published in the same discipline during the same period of time and k is the greatest number of authors per paper in that discipline.

10.5.2. Degree of Collaboration (DC)

The measure was suggested by Subramanyam and is expressed as follows:

$$DC = 1 - \frac{f_1}{N}$$

10.5.3. COLLABORATIVE COEFFICIENT (CC)

Ajiferuke pointed out that the above two measures were inadequate and suggested a single measure, which incorporates some of the merits of both and calls it a collaborative coefficient. The method is based on fractional productivity defined by Price and Beaver[11]. It is given by the following formula and the symbols used in the formula have been explained above under the collaborative index.

$$CC = 1 - \frac{\sum_{j=1}^{k} (\frac{1}{j}) f_j}{N}$$

According to Ajiferuke, CC tends to zero as single-authored papers dominate and to 1-1/j as j-authored papers dominate. This implies that the higher the value of CC, the higher the probability of papers with multi or mega authors. Here multi authors imply papers with 3 or 4 authors and mega authors with more than 4 authors. However, the inclusion of authors as multi or mega can be changed according to the data to be analyzed.

10.5.4. Co-authorship Index

The above measures do not indicate which type of authors dominates the collaboration. To overcome this problem, Garg and Padhi suggested the Co-authorship Index (CAI) which indicates the type of co-authorship that dominates the authorship pattern.

Co-authorship Index is obtained by calculating the proportional output of single, two, multi and mega-authored papers for different nations and for different disciplines or sub-disciplines in science and technology. The methodology is similar to the one suggested by Price and used to calculate Activity Index (AI) suggested by Frame[14] and elaborated by Schubert and Braun.

Here CAI = $\{(N_{ij} / N_{io}) / (N_{oj} / N_{oo})\} \times 100$ where

N_{ij} = Number of papers having j-authors from country i,
N_{io} = Total output of country i,
N_{oj} = Number of papers having j-authors from all countries,
N_{oo} = Total output for all countries included in the study, and
j = 1, 2, (3,4) and (>5)

CAI = 100 implies that a country's co-authorship effort for a particular type of authorship corresponds to the world average, CAI > 100 reflects a higher than average co-authorship effort, and CAI < 100 lower than average co-authorship effort by that country for a given type of authorship pattern.

Other measures suggested by Garg and Padhi are used to compute domestic and international collaboration as the above indicators do not indicate the nature of collaboration i.e. domestic or international. These are the domestic collaborative index and international collaborative index and have been described below.

10.5.5. Domestic Collaborative Index (DCI)

The domestic collaborative index is obtained by calculating the proportional output of domestically co-authored papers. For calculating DCI papers written in local and domestic collaboration are to be added together.

Here DCI = $\{(D_i / D_{io}) / (D_o / D_{oo})\}$x 100 where
D_i= Number of domestically co-authored papers for country i,
D_{io} = Total output for country i,
D_o = Number of domestically co-authored papers from all countries,
D_{oo} = Total output for all countries included in the study.

10.5.6. International Collaborative Index (ICI)

The value of ICI is obtained by calculating the proportional output of internationally co-authored
papers.
Here ICI = $\{(I_i / I_{Io}) / (I_o / I_{oo})\}$ x100 where
I_i= Number of internationally co-authored papers for country i,
I_{Io} = Total output for country i,
I_o = Number of internationally co-authored papers for all countries,
I_{oo} = Total output for all countries included in the study.

The value of DCI or ICI = 100 indicates that a country’s collaborative effort corresponds to The world average. DCI or ICI > 100 reflects collaboration higher than the world average and DCI or
ICI < 100 reflects collaboration less than the world average.

10.5.7. Salton’s Measure for computing collaborative strength

The measure was suggested by Salton and Bergmark[16]. It measures collaborative strength between various pairs of countries or regions. It is expressed by the following formula.

$$r_{ij} = \frac{p_{ij}}{\sqrt{p_i p_j}}$$

Where entities i and j represent pair of countries or regions to be compared, P_{ij} are the number of collaborated publications between countries/regions i and j, P_i and P_j are publications of countries/regions i and j and r_{ij} is the mutual collaborative strength between countries/regions I and j.

10.6. STEPS INVOLVED IN THE CALCULATION OF VARIOUS MEASURES

The following steps are involved in the calculation of the above-mentioned measures. Downloading of data from an appropriate database like Web of Science or Scopus;

- Identification of single, two, multi and mega-authored papers; (For calculating CC each type of authorship is to be counted separately, while for calculating CAI co-authored papers can be clubbed as multi and mega-authored papers as has been mentioned above in the definition of CAI).
- Identification of domestically and internationally co-authored papers to calculate DCI and ICI;
- Identification of different countries with which a country has collaborated to calculate Salon's measure.

Calculation of the above-mentioned measures using the suitable data is given in Appendix.

10.7. WHAT CAN BE MEASURED WITH DATA ON COLLABORATION?

The following can be computed with the help of data on co-authorship/collaboration.

- Pattern of co-authorship/collaboration of different nations, agencies and institutions.
- Pattern of co-authorship/collaboration of different sub-disciplines of science and technology as well as of sub-specialities of a discipline.
- Pattern and type of collaboration whether local, domestic or international.
- Change in the pattern of co-authorship/collaboration over a period of time.
- Volume of collaboration and change in it over a period of time.
- Type of collaboration like bilateral or multilateral.
- Disciplines where collaboration occurs most.

It has been illustrated with the help of data on international and domestic output in the field of laser science and technology, a sub-field of physics.

10.7.1. Co-authorship and collaborative pattern according to countries

Table 1 presents the distribution of output by single, two, multi and mega-authored papers besides the values of the CAI and CC for each country. The average value of CC for laser science and technology is 0.58. This implies that the collaborative pattern in the field of laser science and technology is mainly characterized by co-authored papers and not by single-authored papers. It also indicates that Japan, France, Italy, Netherlands, and Switzerland had more than the average value of CC (0.58), which implies that these countries must have higher values of CAI either for multi or mega-authored papers. An examination of data (Table 1) indicates that except Switzerland all other above-named countries had the highest values of CAI for mega-authored papers. For Switzerland, the reason for the higher value of CC is the absence of single-authored papers. The value of CAI for mega-authored papers is higher for France and Japan because these two countries pay more attention to application-oriented laser research. Canada, China, and Australia had emphasized more on theoretical laser research[17] hence these countries have low values of CC and higher values of CAI for single-author papers.

Table 1: Pattern of authorship among different countries in Laser S&T during May 1991- April 1990

Country	Single authored papers	Two authored papers	Multi-authored papers	Mega authored papers	Total papers	Collaborative Coefficient (CC)
USA	202 (114)	352 (98)	540 (95)	310 (104)	1404	0.58
Japan	31 (55)	85 (75)	204 (114)	123 (131)	443	0.65
USSR	51 (102)	94 (99)	158 (104)	68 (86)	371	0.58
UK	19 (65)	81 (136)	97 (103)	35 (71)	232	0.59
Germany	17 (92)	43 (115)	58 (98)	28 (90)	146	0.58
France	8 (45)	19 (52)	64 (111)	51 (169)	142	0.67
Canada	17 (160)	37 (172)	23 (68)	7 (39)	84	0.48
Italy	4 (69)	13(110)	17 (91)	12 (123)	46	0.61
China	20 (220)	13 (70)	28 (96)	11 (72)	72	0.48
India	6 (78)	25 (160)	25 (101)	5 (39)	61	0.55
Israel	9 (142)	9 (70)	29 (143)	3 (28)	50	0.54
Netherlands	4 (70)	9 (78)	19(104)	13(136)	45	0.64
Switzerland	--	18 (184)	12(78)	8(99)	38	0.63
Australia	13(52)	17 (166)	10 (62)	--	40	0.39
Total	401	815	1284	674	3174	0.58

Multi-authored: Papers with 3/4 authors, Mega-authored: Papers with 5 or more authors, (CAI) Co-authorship Index for different countries.

10.7.2. Domestic and international collaboration profile of different nations

The domestic and international collaborative profile has been calculated by using the domestic collaborative index and international collaborative index mentioned above. The results of the Domestic Collaborative Index (DCI) and International Collaborative Index (ICI), besides, the number of papers for each country written in local, domestic and international collaboration are given in Table 2. The number of papers written in domestic collaboration is much more compared to papers written in international collaboration.

Among the countries listed in Table 2 only four countries, viz. USA, Japan, France and India have more than the average value of DCI. The reason for the higher value of DCI for the USA and Japan is mainly due to the links of AT&T Bell Labs (USA) and NTT (Japan) with their sister concerns scattered in different regions of the USA and Japan respectively. The value of DCI for India is higher because of the concentration of resources and types of equipment at Bhabha Atomic Research Centre, which has large links with other institutions in India.

Regarding ICI it is observed that China, Israel, Netherlands and Switzerland have very high values of ICI. This can be explained on the basis of the argument provided by Frame and Carpenter[18] that “international collaboration is inversely proportional to the size of the scientific enterprise in a country and the more basic the field, the greater the probability of international co-authorship". In the case of these four countries, the total output in mainstream science journals in laser science and technology is about 6.5% of the world output and all four countries emphasised theoretical laser research. In the case of Italy also, the same argument holds good. For China, the open-door policy of the post-Mao leadership led by Deng Xiaoping seems to be working. Switzerland in general has high international links in physics.

The value of ICI for the USA, Japan and the erstwhile USSR is less than the world average. These countries are the major producers of scientific output in laser science and technology, which leads to the conclusion that laser science and technology in these countries are well developed. Hence these countries do not require a higher magnitude of international collaboration. Another reason for low ICI for the erstwhile USSR was their political relations with other developed countries as well as the language of communication. For Japan, the low value of ICI is because of its emphasis on application-oriented laser technology as well as the language. India, Australia and Canada have to improve their international collaboration as the values of ICI for these countries are low.

Table 2: Local, domestic and international collaboration among different nations in Laser S&T during May 1991-April 1990

Country	Local Collaborative papers	Domestic Collaborative papers	Total	DCI	International collaborative papers	ICI	Total papers
USA	43	241	284	122	63	89	1404
Japan	22	75	97	132	8	36	443
USSR	-	6	6	10	8	43	371
UK	2	32	34	88	20	171	232
Germany	2	19	21	87	13	177	146
France	5	24	29	123	10	140	142
Canada	1	9	10	72	2	47	84
Italy	-	8	8	105	4	173	46
China	1	6	7	59	9	248	72
India	7	9	16	158	3	98	61
Israel	1	5	6	72	6	238	50
Netherlands	2	6	8	107	5	220	45
Switzerland	-	1	1	16	7	365	38
Australia	-	-	-	-	2	99	40
Total	86	441	527	-	160		3174

Further analysis of the raw data indicates that the USA had the largest number (39%) of internationally co-authored articles followed by the UK, Germany, and France, which constituted about 12.5%, 8% and 6% of the internationally co-authored articles. However, European countries together constituted about 37% of the internationally co-authored articles. The three Asian countries namely Japan, India and China constituted 12.5% of the internationally coauthored articles. Among these three countries, India had the lowest number of internationally co-authored articles. The findings support the fact that OECD countries are the major collaborators and the countries from Asia constitute a small fraction of internationally coauthored publications. It is also observed that expect six papers; all papers had only bilateral collaboration. The USA is the most important partner country for all the countries listed in the Table below.

10.7.3. Collaboration pattern according to agencies/institutions

Table 3 provides data on the number of collaborative papers published by different types of agencies like academic institutes, research institutes, industrial houses, and government organizations. It indicates that most of the collaborations have resulted from academic institutions followed by industrial houses and research institutions. Further analysis of raw data indicates that most of the collaborations from industrial houses and government organizations are from USA and Japan. Using a similar methodology one can identify institutions that are involved in collaboration in different countries. Analysis of the distribution of the total output of the papers by a number of institutions indicates that most of the collaborative papers have resulted from the bilateral collaboration of the institutions.

Table 3: Distribution of collaborative papers according to the type of agencies in Laser S&T during May 1990-April 1991

Type of institution	Local	Domestic	International	Total	%
Acad. Institution	36	237	91	364	52.98
Res. Institution	9	83	35	127	18.49
Industrial Houses	39	83	25	147	21.40
Government Orgn.	2	38	9	49	7.13
Total	86	441	160	687	100

10.7.4. Co-authorship pattern according to Sub-specialities

Table 4 shows the pattern of co-authorship for various sub-specialities. It indicates that theoretical laser research requires less collaboration while experimental and application-oriented laser research requires more collaboration.

Table 4: Co-authorship pattern in different sub-specialities of Laser S&T during May 1990-April 1991

Code	Single authored papers	Two authored papers	Multi authored Papers	Mega authored papers	Total papers	Collaborative Coefficient(CC)
B	194 (195)	302 (150)	258 (81)	31 (18)	785	0.64
C	119 (61)	303 (76)	662 (106)	462 (141)	1546	0.60
D	88 (83)	210 (97)	364 (107)	181 (101)	843	0.58
Total	401	815	1284	674	3174	

B: Theoretical Laser Research, C: Experimental Laser Research, D: Applications of Lasers, (CAI) Co-authorship Index for different sub-specialities.

The value of CC for theoretical laser research is lower than the values of CC for experimental and application-oriented laser research. Similarly, the values of CAI for multi and mega-authored papers are higher for experimental and application-oriented laser research. Similarly, it can be applied to computing co-authorship patterns among broad disciplines of science and technology.

10.7.5. Collaborative profile according to sub-specialities

An analysis of the collaborative profile can also be made according to the sub-specialities of laser science and technology. The number of collaborative papers in different sub-specialities of laser science and technology is given in Table 5 which indicates that most of the collaborations are in experimental laser research followed by application-oriented laser research. This is in accordance with what has been stated earlier under the co-authorship index (Table 4) that theoretical laser research had a low value of CC and a higher value of CAI for single-author papers. However, the proportion of internationally co-authored papers is higher for theoretical and experimental laser research as compared to application-oriented research.

Table 5: Distribution of collaborative papers according to sub-specialities in Laser S&T during May 1990 –April 1991

Sub-specialty	Local	Domestic	International	Total (%)
Theoretical	14	82	61	157 (22.85)
Experimental	42	225	63	330 (48.03)
Application	30	134	36	200 (29.11)
Total	86	441	160	687 (99.99)

10.7.6. Change in the pattern of collaboration over a period of time

Table 6 presented below indicates the values of CC and CAI for different periods in five blocks from 1970-1994 for Indian output in laser science and technology. It clearly shows that in the last block (1990-1994) the value of CC, as well as CAI, is highest. This implies that over a period of time the number of multi and mega authored papers have increased.

Table 6: Pattern of co-authorship during different blocks Of India in Laser S&T

Year	Single authored papers	Two authored papers	Multi authored papers	Mega authored papers	Total	Collaborative Coefficient (CC)
1970-1974	17 (139)	42 (120)	25 (80)	00 (00)	84	0.45
1975-1979	34 (131)	78 (105)	66 (100)	1 (8)	179	0.48
1980-1984	32 (102)	97 (108)	81 (101)	6 (41)	216	0.50
1985-1989	34 (104)	82 (90)	91 (110)	16 (105)	223	0.52
1990-1994	22 (60)	95 (92)	91 (97)	42 (255)	250	0.57
Total	139	394	354	65	952	0.52

10.8. SUMMARY

Collaborative research is an important feature of science. Collaboration can be defined as the working together of two or more researchers to achieve the common goal of producing new knowledge. Governments in different countries have taken initiatives to enhance collaborative research programs and such initiatives have resulted in increased collaborations at national and international levels. Statistical data indicate that percentage of research produced by teamwork has been growing steadily for more than half a century. However, the extent of collaboration and their rate of growth varies from one subject to another. Based upon the type of participants and the location etc, collaboration can be categorised into three broad categories. These are local collaboration, domestic collaboration and international collaboration. Among all these types of collaborations, international collaboration has received the maximum attention. Different measures of collaboration suggested in the literature are Collaborative Index (CI), Degree of Collaboration (DC), Collaborative Coefficient (CC), Co-authorship Index (CAI), Domestic Collaborative Index (DCI), International Collaborative Index (ICI) and Salton's measure for computing collaborative strength between various pair of countries or regions.

10.9. MCQ QUESTIONS

1. Different types of collaborations are ____________

2. A collaboration that occurs between scientists of two departments of the same institute is known as ____________

3. A ________ collaboration takes place when scientists from two or more institutes within the country collaborate.

4. An ____________collaboration occurs when institutions from two or more countries join hands.

5. _____________ is the country that has the highest number of collaborating partners in the world.

6. Statistical data indicate that percentage of research produced by teamwork is A. Growing steadily B. is constant C. is decreasing.

7. The rate of growth of collaboration A. is field independent B. is field dependent C. none of the two.

8. The rate of growth of collaboration A. does not differ from country to country B. differs from one country to another country C. none of the two.

9. Articles written in international collaboration receive A. more citations B. fewer citations C. no citations than articles written in domestic collaboration.

10. Collaborative Coefficient was suggested by A. Ajiferuke B. Lalwani C. Subramanyam

11. Collaboration does not extend beyond institutional and national boundaries. False/True

12. Domestic collaboration involves the working of scientists from two different countries. False/True

13. Collaboration is defined as the working together of two or more researchers to achieve the common goal of producing new knowledge. False/True

14. The extent of collaboration and its rate of growth varies from one subject to another. False/True

15. One of the important reasons to collaborate is to obtain prestige or visibility for professional advancement. False/True

16. Citation analysis can be used to study A. the influence of the research output B. the output of a country C. collaborative links between two countries

17. Frequency with which two items of earlier literature are cited together by the later literature is called A. Bibliographic coupling B. Co-citation

18. Given an example for the application of social network analysis in LIS domain A. Can be applied in measuring web data B. Can be applied in measuring online research output C. Can be applied in identifying authorship trends D. Can be applied in studying co-authorship collaboration

19. Subramanyam suggested _______________

20. Garg and Padhi suggested ______________

10.10. SHORT QUESTIONS

What is collaboration?

What are the reasons for collaboration?

What can be measured with data on collaboration?

what is Collaborative Index?

What is the collaboration coefficient?

10.11. LONG QUESTIONS

How much is a collaboration worth a calibrated bibliometric model?

What are the different collaboration methods?

What is international collaboration? Discuss in detail.

KEYWORDS: Collaboration; Collaborative index; Collaboration coefficient; Bibliometric model

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UNIT 11
SCIENTOMETRIC STUDIES AND THEIR ROLE IN SCIENCE POLICY

11.0. OBJECTIVES

- o To understand the importance of measurement activity in science for science policy/decision making.
- o To learn the basic concepts of technology forecasting and how scientometrics emerges as an important tool for technology forecasting.
- o Highlights thorough examples of the application of scientometrics in science policy.

11.1. OUTCOME OF LEARNING

At the end of this unit, you studied measurement activity in science for science policy/decision making. Also, you have learnt basic concepts of technology forecasting and how scientometrics emerges as an important tool for technology forecasting. Modules highlighted thorough examples of the application of Scientometrics in science policy; thus you have also gained knowledge with regard to the application of scientometrics to science policy.

11.2. STRUCTURE OF UNIT

- o Introduction
- o What is technology forecasting (TF)?
- o Bibliometric analysis: one of the popular methods in technology forecasting
- o Usefulness in the context of the foresight study
- o Example: predicting the growth of the scientific field
- o Example: forecasting a Country/company's probability of success
- o Case studies on the application of Scientometrics in Technology forecasting
- o Summary
- o References

11.3. INTRODUCTION

The measurement of scientific activity evolved in the late 1960s as a practical need for a rational policy decision in scientific research. The strong demand for an objective method of evaluation of scientific activity came from competitive funding pressure of different streams of research. Other perspectives that supported the objective approach were the advent of a more organized scientific research activity/mission mode approach, science playing a much larger role in the economy and society, and scientific research increasingly requiring larger funding support from the government (Edge, 1995). Thus from the 1960s onwards-evidence based measurement of scientific activities – authentic data collected on scientific activities and analyzed on a regular basis started playing an important role in the formulation of science policy. Scientometrics is primarily involved in constructing S&T indicators that can properly measure the various aspects of the latent variables of 'scientific activity (for example productivity, and quality). Indicators are constructed from the empirically directly measurable variables (for example publications, citations, patents) which are used to judge indirectly the state or dynamics of the corresponding latent variables. Scientometric research has led to the construction of varied types of indicators that can address the following main types of scientific activity:

- Dynamic aspects – growth of scientific knowledge, signalling the new areas of research, etc.;
- Structural aspects – mapping the cognitive structure of scientific knowledge;
- Evaluative aspects- assessment of scientific research; and
- Prognostic-future studies.

In spite of some major inherent limitations, the approach of analysing scientific activity through S&T indicators has come to stay; the debates have now shifted to how well one can construct better indicators and collect statistics. The Scientometrics method has become more popular and relevant because it can reveal the 'hidden aspects' of research activity and can signal policy actions. The evidence-based studies provide important inputs for policy actions.

One of the influential findings from the analysis of research papers has been the role of research collaboration in the advancement of scientific research (Bhattacharya et al. 2012). The study highlights the role of collaboration in nanotechnology, a fast-growing field of research with diverse applications across various sectors. Analysis of research papers in this field shows that papers from India in nanotechnology have a high impact when the authors belong to different institutions. For example, 26 papers were identified from India in the top 1% cited papers globally in nanotechnology in 2009. Of the 26 cited papers, 16 papers (61%) were found to be collaborative papers. Again examining Indian publications in nanotechnology, journals with a high impact factor showed collaboration playing a major role. Looking at the high reception of papers from China also brought out this fact. In a sense, strong evidence emerges that collaboration has played an important role in pushing the quality of scientific research in nanotechnology for both India and China.

Similarly, examining the patenting activity of India and China in nanotechnology in the US Patent Office reveals some interesting trends and insights. The joint patenting among Hon-Hai Precision Industry Ltd. and Tsinghua University are striking. Tsinghua University is a leading University in China, part of the C9 League that comprises the top 9 universities in China and is among the top 100 universities in different global university rankings. Hon-Hai Precision Industry is a Taiwan-based entity, commonly known by its trade name, Foxconn and is the world's largest contract electronics manufacturer. The joint patent activity has led to the filing of 118 patents during the period 2001-09 accounting for 72% of patents filed by China in nanotechnology. Similarly, it has led to the grant of 22 joint patents which is 49% of the patents granted to China during the period 2001-09. The examination of their joint patents provides an indication of the inventive capability that is developing over the years in China.

Further analysis of the trends of these joint patents shows the importance of the patents filed for future application development. The early applications are in varied methods of growing carbon nanotubes. Later patents address specific applications of carbon nanotubes i.e. yarn (textile), microscopic electronics, nanoscale integrated circuits, nano-based display panels (for computer, LCD, TV and mobile screen), Lithium battery, composite material for automotive, carbon-based array sensors and electron emission device. Thus, it is observed that the joint activity is not only strengthening over the years but is also directed to specific applications. Important indications like this can be revealed through bibliometric analysis and based on these indications policy/decision-making can be strengthened. From the above two examples, policymakers can observe the important role of collaboration in strengthening scientific and/or technological competency. Suitable institutional mechanisms can be adopted by a country to strengthen collaboration further.

11.4. WHAT IS TECHNOLOGY FORECASTING (TF)?

An important contribution of scientometrics is also found in Technology Forecasting which is primarily understood as all purposeful and systematic attempts to anticipate and understand the potential direction, rate, characteristics, and effects of technological change, especially invention, innovation, adoption, and use. Primarily it refers to a set of methods/techniques to identify future technology developments and their interactions with society and the environment for the purpose of guiding actions designed to produce a more desirable future.

Technology Forecasting (TF) usually focuses on specific technologies, but sometimes the scope is more encompassing. A firm might roadmap a set of related technologies and products; an industry association might roadmap the range of emerging technologies potentially affecting its sector, or a nation could roadmap technologies across its economic base. A new conceptual area/framework has evolved which is called Technology Future Analysis (TFA) which includes Technology Forecasting as a sub-discipline. This framework articulated by Porter (2004) has found wide adoption. In this context let us know what constitutes TFA.

11.4.1. Technology Future Analysis Primarily Covers:

- Technology monitoring, technology watch, technology alerts (gathering and interpreting information);
- Technical intelligence and competitive intelligence (converting information into usable intelligence);
- Technology forecasting (anticipating the direction and pace of changes);
- Technology Road-mapping (relating anticipated advances in technologies and products to generate plans);
- Technology assessment, and forms of impact assessment, including strategic environmental assessment (anticipating the unintended, indirect, and delayed effects of technological changes); and
- Technology foresight, also national and regional foresight (effecting development strategy, often involving participatory mechanisms).

Among its various applications are: prioritizing R&D, input to public policy, strategic decisions on technology, and so forth.

11.4.2. Some Common Methods of Technology Forecasting

Expert Opinion: Delphi (iterative survey); Focus Groups [panels, workshops]; Interviews;

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[1] For the purpose of this research document, technology future analysis and technology forecasting are used inter-changeably.

Modelling and Simulation: life cycle analysis; Systems Simulation; Economic base modelling [input-output analysis]; Technology Assessment; and Scenarios: Scenario-simulation [gaming; interactive scenarios].

11.4.3. Scientometrics and Technology Forecasting

Scientometrics plays an influential role/instrument in the application of several of the above forecasting methods. For example, in many Delphi study choice of experts is based on identification done through mapping research profile. Authors who are highly cited or research groups/institutes are uncovered which provides an objective and more precise method for expert selection.

On the other hand, common forecasting techniques are applied to the bibliometrics data to reveal new insights. For example, research publication activity and patenting activity over a period of time is a common approach in trend analysis and technology watch. It provides for the decision maker and or researchers/ research groups to have a more informed understanding of the development in a field and allows for simulation and scenario building (extrapolation through forecasting methods of how the field is. expected to develop). This is very useful for decision-based analysis such as funding support, a roadmap for technology development and impact, undertaking strategic decisions, etc.

11.5. BIBLIOMETRIC ANALYSIS: ONE OF THE POPULAR METHODS IN TECHNOLOGY FORECASTING

Bibliometrics is the statistical analysis of text documents, typically publications and patents. Since publications, in this case, refer mainly to scholarly journals and patents, science and technology-intensive industries would logically be a better fit for this type of analysis. As patents and scholarly journals often deal with ideas and techniques relatively in the early stages of technology development, this is the stage at which bibliometric methods for technology forecasting are most useful. In later stages, the exploitation of knowledge takes place which requires a large amount of tacit knowledge (know-how, practical knowledge) which cannot be captured by bibliometrics.

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[1] For the purpose of this research document, Scientometrics and Biblometrics are used inter-changeably.

science policy decisions/formulation of S&T roadmaps.

11.6. USEFULNESS IN THE CONTEXT OF FORESIGHT STUDY

Help Identify emerging scientific specialities and research areas; research fronts where the action is taking place;

Bibliometric data can be adjusted (mapped or compared) using an S curve as a way to fit the technological growth process (applying models such as Fischer-Pry Model); Technology clustering based on: (a) Co-occurrence analysis of patent classification codes/keywords from titles or abstracts; (b) Mapping Patent citation network; Patent citation network can help identify in any area of technology: (a) The technology plane, such as; Precursor and Successor technology; (b) Key patents, key companies, inventors; (c) Identify interactions between science and technology etc.; Core competency of countries in an area of scientific research or technology; and Expert selection within a field.

11.7. EXAMPLE: PREDICTING THE GROWTH OF THE SCIENTIFIC FIELD

The application of the exponential growth model to science in terms of the number of units of scientific productivity: growth of scientific papers (Price 1961); Science like any other growth phenomenon seems subject to a description in terms of logistic growth rather than pure exponential growth; Why this type of growth happens/ processes or activities behind this Growth? The existing stock of scientific literature doubles every fifteen years, it does not necessarily mean that this growth rate applies to every single discipline and sub-discipline; From an analysis of growth data it appears, contrary that scientific disciplines and sub-disciplines may vary widely with respect to the growth rate.

The concept of linear growth, exponential growth and logistic growth are highlighted in the figure given below (adapted from Price, 1961). Linear growth implies an increase with a fixed quantity of units for each unit of time. It is an exponential growth if the increase is in a fixed proportion of the total population for each unit of time. Logistic or S-shaped growth is a combination of exponential growth and asymptotic growth whereby after an initial exponential phase, growth gradually slows down as the population approaches saturation level. Adopted from Science Since Babylon (Price 1961).

11.8. EXAMPLE: FORECASTING A COUNTRY/COMPANY'S PROBABILITY OF SUCCESS

Patent-based Indicators can address to some extent the technology part of the forecasting problem, by analysing: Which of the companies has the most valuable portfolio of patents? How concentrated is a company's R&D across different technology categories? etc.

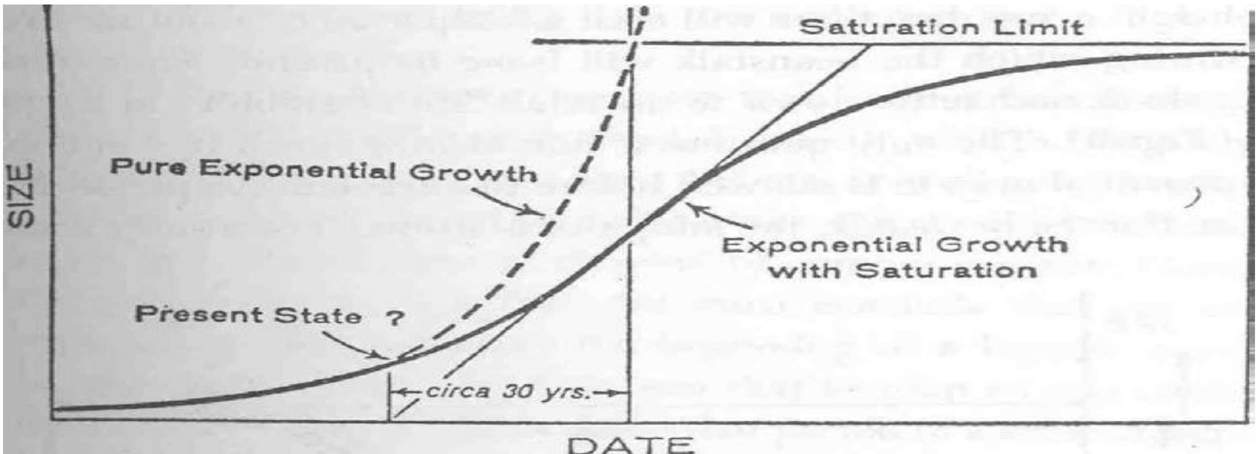

Fig. 5. GENERAL FORM OF THE LOGISTIC CURVE

Some of the Indicators that are used in this type of analysis are:

- Number of Patents: Granted by a Patent Office (say Indian Patent Office); Number of cited references Per Patent: A count of citations received by a company's patents (for example year-wise or otherwise);
- Current Impact Index: Measure based on how often a company's patents are cited by other patents;
- The number of times a company's most recent five years of patents are cited in the current year, relative to the entire patent database; and
- Technology Strength: The number of patents times the current impact index (will indicate the technology strength of a company's newly issued patents).

11.9. CASE STUDIES ON THE APPLICATION OF SCIENTOMETRICS IN TECHNOLOGY FORECASTING

11.9.1. A case study of GlaxoSmithKline adopted from Norling et al. (2000).

Just after the merger of SmithKline with Beecham (1990), the question of focus was to guide the company in refocusing its R&D resources. The application of scientometrics or science mapping was used as one element in the redirection of its R&D resources. Scientometric maps of the seven therapeutic areas were generated in which the merged company was also active. From this, they concluded that the field of gastrointestinal disease (GI) research in particular was not generating a significant amount of high-performance research. The company decided to close its research activities in this area and focus on research in the remaining six areas. This Scientometric study gave the company an important intelligence perspective that enabled it to reshape its research portfolio for greater productivity and to define a number of promising technology opportunities**.**

11.9.2. Study of the Importance of public funding for research for industrial competency adopted from Broad, W.J. (1997)

CHI Research Study in 2004 demonstrated the importance of public science in generating key input for subsequent patents in technology areas. This study showed substantial citations to research papers in patents. It also highlighted the role of public-funded institutions as almost 73% of research papers cited in patents emerged from public-funded institutes (44% from publicly funded research institutions in America and the rest 29% from foreign public-funded research institutions). This work contributed significantly to the increase in research grants for public science in the USA. It also got noticed in other countries and had a high spin-off effect. i.e. many countries increased their outlay for public science.

11.9.3. Case study An-Cheng and Chen (2008): Technology forecasting of new materials (e.g. Nano-sized ceramic powders)

The authors adopted the bibliometric analysis through the EI database and U.S. Patents and Trademark Office (USPTO) database to gain useful data for this work. This study applied the growth curve method to investigate the technological performances of Nanosized ceramic powders. The study found that Nano-sized ceramic powders were all in the initial growth periods of technological life cycles. The technology performances of Nano-sized ceramic powders through the EI and USPTO databases were similar. The bibliometric analysis was proposed as a simple and efficient tool to link the science and technology activities, and to obtain quantitative and historical data for helping researchers in technology forecasting, especially in rare historical data available fields, such as the new materials fields.

11.9.4. Case Study Chen and Cheng Wang (2010): Predicting the development trend of the walking technique

The authors extracted patent amount information of the biped robot walking technique in Japan from the patent database of the Japan Patent Office. The study then analyzed the extracted information using the S-curve Loglet Lab, Pearl and Gompertz models in order to predict the development trend of the walking technique in Japan. According to the results of the analysis, the biped robot walking technique in Japan will continue to grow and reach saturation in the period 2079–2082. This type of finding helps business managers and technical developers to manage their strategies for developing the techniques. It is feasible to predict the development trend of technology using the approach presented in this study.

11.10. SUMMARY

The unit highlights the utility of scientometric studies in decision-making/policy making. Technology forecasting provides an informed view of technology, its development and future trends and hence is an important tool in decision making. The module provides a conceptual understanding of technology forecasting and highlights how scientometric methods also apply in technology forecasting. The module highlights Scientometrics is increasingly being applied in science policy studies. Indicators constructed from scientometrics can reveal the dynamics of a research field, how it is developing, and the core competence of different research groups or nations at large. It can show gaps in a country's research profile and can identify to what extent its research has the ability to inform technological development (for example examining how often research publications are cited by its patents, etc), or show a firm/country's technology preparedness (say examining a firm/country patenting activity in emerging areas such as stem cell research, nanotechnology, etc.).

In technology forecasting, Scientometrics is playing a key role. For example, in many Delphi study choice of experts is based on identification done through mapping research profile. Authors who are highly cited or research groups/institutes are uncovered which provides an objective and more precise method for expert selection. Text mining helps to identify conceptual connections between apparently disjoint areas of research. For example, it has been applied in medical research to identify connections between different health problems, etc. Trend analysis based on research publication activity and patenting activity over a period of time is frequently undertaken. It provides for the decision maker and or researchers/research groups to have a more informed understanding of the development in a field and allows for extrapolation through forecasting methods of how the field is expected to develop. This is very useful for decision-based analysis such as funding support, creating the roadmap, undertaking strategic decisions, etc. The scientometric approach however requires deeper introspection to make it more acceptable to the scientific community and science policy/decision-making. Problems of scientometric-based research that require attention can largely be categorized under methodological issues, issues of databases that include data mining and visualization tools, lack of integration of scientometrics research with other disciplines and the need for adopting a reflexive/self-critical approach. Some key issues are highlighted below.

One pressing issue that calls for attention is the problem of interrelation between the S&T indicators and latent variables. Are the indicators chosen really measuring the latent variable and what aspect of the latent variable it measures requires deeper introspection?

Different databases have small overlaps in records. For example, it has been estimated that there is only a 52% overlap between two popular bibliometric databases namely Scopus and web-of-Science. Non-article items are less covered by standard databases, making the bibliometric approach more difficult. The lack of unification of items in a database is another concern. Mapping and delineation of scientific fields are related issues which call for developing a proper search strategy for the extraction of records. Scientometric analysis reveals various aspects of the scientific and technological communication process by exploiting publication, citation and patent data. For example, it can show linkages among institutions, concepts, patterns of knowledge growth within the sub-grain analysis, identify the key papers/patents, long-term research and technology trends, and identify the scientific community among others. This rich scientometric data provides an 'object of investigation' for studies within various disciplines such as sociology of science, science, technology and innovation studies, strategy studies etc. In spite of this wide reach of scientometric tools and rich data, it has not entered in the mainstream research methods of other disciplines.

11.11. MCQ QUESTIONS

1. Scientometric studies involve A. Opinion Survey B. Expert Evaluation C. Capturing Know-how D. Analysis from textual data

2. Technology Forecasting does not include A. Content Analysis B. Expert Opinion C. Trend Analysis D. Modelling and Simulation

3. Logistic or S-shaped growth is A. Exponential growth B. Combination of exponential growth and asymptotic growth C. Linear growth D. Combination of exponential and linear growth

4. Scientometrics provides objectivity in decision-making. True/False

5. Technology forecasting techniques are not suitable for scientometrics. True/False

6. Research papers cited in patents show the importance of scientific research in technology development. True/False

7. Patent statistics are not relevant in bibliometric studies. True/False

8. Linear growth is when a population grows at a constant rate over a period of time. True/False

9. Patent citation analysis can be useful for technology. True/False

10. Publication counts indicate the quality of the work of the researcher. True/False

11. Dynamic aspects of the _______________

12. Structural aspects ________________

13. Evaluative aspects ______________

14. Prognostic __________

15. Shepherd's citations published in: A. 1873 B. 1973 C. 1773 D. 1673

16. The inventor of the Science Citation Index: A. D. S Price B. E. Garfield C. Lancaster, F.W D. Goffman, William

17. The Institutional Productivity: A. The research output of an institution B. Material Production of an institution C. Group of Employees production D. Identification of institutional linkages

18. Who propounded the law of scatter? A. George Kingsley Zipf B. Samuel Clement Bradford C. Jean-Baptiste Estoup D. None of the above

19. For the verification of which law author index is used? A. Lotka's law B. Bradford's law C. Zipf's law D. None of the above

20. What was the profession of Alfred J Lotka? A. Librarian B. Documentalist C. Statistician D. Above all

11.12. SHORT QUESTIONS

What is meant by technology forecasting?

What are the benefits of technology forecasting?

Which one is the method of technology forecasting?

11.13. LONG QUESTIONS

What are the three types of technology forecasting techniques?

What is technology forecasting of bibliometrics explained in detail?

KEYWORDS: Forecasting; Technology forecasting; Method of technology forecasting

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UNIT 12
CHALLENGES OF BIBLIOMETRIC AND SCIENTOMETRIC STUDIES

12.0. OBJECTIVES

- o Understand the importance of bibliometric analysis
- o Identify the various indicators used in bibliometric studies
- o Classify the indicators according to their purpose
- o Appreciate that a number of important qualifications (and limitations) must be borne in mind when assessing the validity of the bibliometric analysis

12.1. OUTCOME OF LEARNING

At the end of this unit, you studied the Challenges of Bibliometric and Scientometric Studies. Also, you have learnt about publication Indicators, Citation Indicators, and Journal Indicators.

12.2. STRUCTURE OF UNIT

- o Introduction
- o Limitations of Bibliometric Analysis
- o Limitations of Citation Analysis
- o Characteristics and Limitations of Bibliometric Indicators
- o Summary
- o References

12.3. INTRODUCTION

Bibliometrics, a term coined by Pritchard in 1969, is a measure used to understand the output and impact of scientific communication. Publications and Citations are the two important variables normally used in bibliometrics. Bibliometrics has arguably provided ways and means of benchmarking and evaluating scholarly work. In recent years bibliometrics has been a growing field of interest in Library and Information Science, yielding to various resultant factors in rankings and decision-making processes in library management and information services to the users. For example, citation analysis is also used as one of the methods employed in user studies.

Bibliometrics – as a method and as a discipline - has received a greater deal of significance since its germination or genesis. One of the important aspects of the increasing interest in bibliometrics, in the libraries as well as in academia in general is the increasing use of bibliometric indicators to evaluate research performance of faculty and researchers, “, especially in the university and government laboratories, and also by policymakers, research directors and administrators, information specialists and librarians and researchers by themselves" (Pendlebury, 2009). The objectivity with which the assessments can be made and the repeatability of the analyses are basic reasons for its popularity. Other reasons, for accepting bibliometrics as a measurement tool, are it's being relatively inexpensive in terms of time, money and effort in its study and provided a good data source is made available. Scalability is one of the main advantages of bibliometrics as a tool. In other words, it can be applied from a micro level, i.e., an individual researcher or an institute, to a macro level, i.e., country or global level. The ability for comparative analyses – temporal, geographic, linguistic, biographic, etc. – in bibliometrics has drawn the attention of many scholars. It has been universally accepted as an ideal method for assessing research productivity.

The use in library administration and management is one of the early applications of bibliometrics. The use of bibliometrics in collection development and management in libraries is a well-known practice, not the least in relation to digital library management. As a student of Library and Information Science (LIS), you would be interested to know that bibliometrics is a well-established part of LIS research. There has been an increase in the number of research activities by the LIS profession in recent years (Naseer and Mahmood, 2009). Not everything is green for bibliometrics. It has received some criticisms as well.

While bibliometric data bring useful information, the implementation often seems to arise from a loss of critical and rational mind and application. In this Unit, an attempt is made to identify and understand the limitations of bibliometrics studies.

12.4. LIMITATIONS OF BIBLIOMETRIC ANALYSIS

Bibliometrics undoubtedly has its distinct strengths. However, it is also subjected to several valid criticisms. Using bibliometrics to measure the quality of scholarly work has attracted the attention of the critiques. As Laloë and Mosser (2009) put it, the use of indices such as the H-index at the level of individuals is easy and therefore attractive, but mostly unscientific. Publication counts, one of the widely used indicators, is criticised for this measure of only the quantity and not the quality. Publication counts have also been subject to other criticisms, such as problems associated with gratuitous co-authoring of articles; different publication practices across fields; and difficulties in defining fields of research especially given strong trends toward collaborative research (Lundberg, 2006). These kinds of criticisms can be seen in other measures also.

12.4.1 Limitations of Citation Analysis

Citation analysis, one of the most applied bibliometrics techniques, is also not far from receiving criticism. Let us try to understand the limitations of citation analysis in more detail in the subsequent section.

There exists a relationship between cited and citing documents, and a citation represents the relationship between them. This is the fundamental principle upon which citation analysis is based. The citation analysis is the area of bibliometrics that deals with the study of this relationship between cited and citing references. Undoubtedly, citation analysis is the most used and useful technique of all. As a concept, it has been responsible for the development of most of the citation databases such as Thomson Reuters's Citation Index, Elsevier's Scopus, Google's Google Scholar and so on. Citation analysis is the basis for the development of 'Citation Indexing' by Eugene Garfield. Citation indexing is a kind of indexing in which the bibliographic references of documents are made searchable and refer to the documents being indexed. The cited references in a document are made to be a part of the subject access points available for information retrieval.

Why do researchers cite? What is the citers' motivation for referencing earlier work? These questions have been comprehensively answered by Garfield (1979), the person who originated the citation analysis. He gives a list of 15 reasons for authors to cite earlier works. On examination of these reasons, one may find some of them really show the scholarly impact; and some of them indicate that they have less-than-noble intention behind them. It is the second category of reasons which attract the attention of the critics; and hampers the very purpose of citation analysis. Citation analysis is based on a few assumptions: 1) Citation of a document implies the use of that document by the citing author; 2) Citation of the document (author, journal, etc.) reflects the merit (quality, significance, impact) of that document (author, journal, etc.); 3) Citations are made to best possible works; 4) A cited document is semantically related in content to the citing document (if two documents are bibliographically coupled, they are related in content; and if two documents are co-cited, they have related in content); and 5) All citations are equal. All these assumptions have inherent flaws in them which are succinctly described below:

- **Criticism about the first assumption**: The first assumption implies that the citing author has either partly or fully used/influenced by the ideas in the cited work; and secondly that all the cited documents were indeed used by the citing author. Failure to meet any one of these conditions amounts to sins of omission and commission. These 'sins' will have a negative impact on the fundamental principle upon which citation analysis is based.
- **Criticism about the second assumption**: The citations received by a document show its quality is the meaning of this assumption. At face value, one may say that there is a positive correlation between the number of citations received and the quality of the article. But it is not always true. Sometimes, citations are received for the wrong reasons also. It has been shown by many studies that the authors have the habit of giving citations to spurious works also. This also shakes the very fundamentals of citation analysis.
- **Criticism about the third assumption**: Studies often show that not all good works are cited. The number of Citations, among other reasons, also depends upon the availability (accessibility) of the documents to the authors. Accessibility of a document may be a function of its form, place of origin, age, and language. Hence, the non-availability of documents may have a negative impact on the citation analysis.
- **Criticism about the fourth assumption:** This assumption has a bearing on the information retrieval function of the citation databases. Martyn (1964) contends that a bibliographic coupling is not a valid unit of measurement because one does not know that two documents citing a third are citing the identical unit of information in it. The same applies to co-citation as well; the fact that two papers are co-cited does not guarantee a common relation- ship between their contents.
- **Criticism about the fifth assumption:** It is not difficult to see that all the papers cited in an article are not of equal importance in the context of the citing work. However, the varying importance of the cited articles is neither reflected in the reference list nor used for citation analysis. This might have a negative impact on the overall results.

Apart from the above, as Smith (1981) lists, the other parameters which may induce errors in the citation analysis are multiple authorship, self-citations, homographs, synonyms, types of sources, implicit citations, fluctuations with time, field variations, and errors. The limitations of citation analysis do not negate its value as a research method when used with care. There are, in fact, several application areas where citation analysis has been used successfully.

12.5. CHARACTERISTICS AND LIMITATIONS OF BIBLIOMETRIC INDICATORS

It is not uncommon to use bibliometrics as the tool for research assessment as it is considered as an objective, quantitative and unobstructed method. These bibliometric indicators have become important for individual researchers and organizations. For researchers, they are important because they provide an objective mode of assessment of diffusion and the impact of articles on their works. For organizations, the bibliometric indicators are significant because they are the means of assessing the quality of particular work, person, or group. However, as said in the last segment of the previous section, the usability of the indicators has to be properly assessed before applying them for quantification. When applied judiciously with care and caution, the bibliometric indicators provide valid results useful for decision-making.

The indicators are normally used as the unit of analysis in various bibliometric studies. The indicators can be categorised, for the sake of explanation here, into three groups, viz., Publication Indicators; Citation Indicators; and Journal Indicators. The following section provides brief explanations of indicators used in bibliometrics under each of these categories along with their advantages and limitations if any. The list is compiled from the list given by Rehn (2007).

12.5.1. Publication Indicators

- **Number of Publications**: It is the number of publications published either by an author, institute, country or so on. The time span is also taken in many situations to suit the temporal scope. The data is collected either directly from the original publications from databases. It is relatively easy to collect data. Although this count is a very straightforward indicator that can be easily calculated by the authors themselves, one must be very careful when using it to compare authors or research groups. The disadvantages of this indicator are: when used does not take the size of the analysed unit, and does not speak of the impact of the publications counted.
- **Number of ISI Publications**: It is the number of publications indexed by Thomson ISI indices. Temporal and geographic filters are applied many times in many studies. Quite easy to collect data as it can be directly collected from the databases. The disadvantages are: when used does not take the size of the analysed unit; has the inherent problem of scope and coverage as that of ISI indices and does not count non-ISI publications.
- **Number of Publications in Top Journals**: It is the number of publications the analyzed unit has published in a selected number of journals during the analyzed time span. The selection of journals is usually made on some criteria. The advantage is that as the data is collected from top journals (which show their relative importance among others in the group); it is a better count than a mere publication count. The disadvantages are: does not take the size of the analyzed unit into account and has the limitations of the selection criteria. Although this approach may look like a performance indicator, it was designed to address the shortcoming of the above-mentioned quantity indicator.

12.5.2. Citation Indicators

- **Number of citations**: It is the total number of references received from other works, i.e., the number of citations to articles published by an analyzed unit during the analyzed time span. The citation of one article by another is characteristic of scientific publications, and it is generally accepted that the number of citations of a particular article receives is a reflection of its impact on the scientific

- community (Rhen, 2006). The data has to be collected from the citation databases such as Thomson Reuters Web of Knowledge, Scopus, Google Scholar, CiteseerX and so on. As collected from databases, data and results are verifiable. Limitations of this indicator include: it does not take into account older articles as usually are more cited that citation rates vary between document types and subject areas, and does not compensate for the size of the unit.
- **Citations per publication**: It is the average number of citations to articles published by an analyzed unit during the analyzed time span. It is calculated by the ratio of total publications and divided by the total number of publications considered. The limitations are: Does not take into account that older articles usually are more cited **Source - http://xkcd.com/285/** if a variable, cumulative citation time window is used, and that citation rates vary between document types and subject areas.
- **Field Normalized Score**: This indicator corresponds to the relative number of citations to publications from a specific unit, compared to the world average of citations to publications of the same document type, age and subject area. It is calculated as follows: The number of citations to each of the unit's publications is normalized by dividing it by the world average of citations to publications of the same document type, publication year and subject area, which is called the field reference value (μf). If an article is classified as belonging to several subject areas, a mean value of the areas is used. The limitations include that if the normalization is done on an article level, a few highly cited articles in a moderately cited research area may contribute un-proportionately to the value of the field normalized citation score.
- **Total field normalized citation score**: This indicator gives an indication of both the impact and the production volume of the analyzed unit. The score is got by adding together the item-oriented field normalized citation scores for all the publications of the analyzed unit. The disadvantage is that it does not compensate for the size of the analyzed unit.
- **Journal normalized citation score**: This indicator corresponds to the number of citations to publications from a specific unit during an analyzed time span, compared to the world average of citations to publications of the same document types, ages and in the same journals. The calculation is as follows: the number of citations to each of the unit's publications is normalized by dividing it by the world average of citations to publications of the same document type, published in the same year in the same journal. The indicator is the mean value of all the normalized citation counts for the unit's publications.
- **Crown indicator**: It is developed by the Center for Science and Technologies Studies at Leiden University. It intends to measure the scientific impact of a researcher or a research group. This indicator is calculated by dividing the average number of received citations (from a researcher or a research group) by the average number that could be expected for publications of the same type, during the same year, and published in journals within the same field (Lundberg, 2007). It has a few flaws also. First, its dependence on categories published by Thompson Reuters leads to a problem that it does not take into account that publications from a particular field are often published in journals categorized in another field. Second, the size of a research group influences its productivity — quite simply, the more researchers in a group, the larger the number of published articles. It is therefore recommended to compare

research groups with the crown indicator only if the groups are of similar sizes (Lundberg, 2007).

- **h-index**: The h-index is an index that attempts to measure both the scientific productivity and the apparent scientific impact of a scientist. J.E. Hirsch introduced it in 2005 and defined it in the following way: "A scientist has index h if h of [his/her] Np papers have at least h citations each, and the other (Np -h) papers have at most h citations each". The 'Web of Science' now gives direct access to the H index with a few mouse clicks. It is calculated as follows: find the unit's published articles in a citation index and sort them in descending order by the number of citations. Count articles from the top of the list and downwards, and when the number of an article rises above the citation count for that very article, the number of the preceding article is to be counted as the h-index. H-index is criticized as it gives a positive bias to senior researchers with older articles since these have
- had more time to be cited, though the demand that new articles with comparable citation levels have to be added has a certain damping effect on that bias.
- **Uncitedness**: It is the share of a unit's publications that remain uncited after a certain time period. Self-citations should be removed from the citation count. It requires data from a comprehensive citation database such as the Thomson citation indices and validation of the unit's publications.
- **Self-citation**: It is the share of a unit's received citations where authors refer to their own papers. The calculation of the self-citation is as follows: count the total number of citations to the unit's publications during the analyzed time span. Check where citations are coming from and count the number coming from the unit itself. Divide the second number with the first to get a share of self-cited. The requirement for getting self-citation is that it requires data from a comprehensive citation database such as the Thomson citation indices, validation of publications and analysis of citing articles, which can be done in the ISI Web of Science.

12.5.3. Journal Indicators

a) Impact factor: The impact factor (IF) of an academic journal is a measure reflecting the average number of citations to recent articles published in the journal and is intended to gauge the importance of a journal in its given field. It is perceived that the higher impact factor of a journal more important it is in that field than those with lower ones. The impact factor was devised by Eugene Garfield, the founder of the Institute for Scientific Information. The impact factor is calculated yearly for those journals that are indexed in the Journal Citation Reports. IFs are available in the SCI (Science Citation Index) Journal Citation Reports and on the Web of Knowledge for more than 8000 selected scientific journals. The IF does have several limitations (Durieux & Gevenois, 2010). First, although a higher IF can suggest a greater impact of a journal, it does not reflect the quality of each particular article published by that journal. Consequently, it is not clear whether a high IF is due to a moderate degree of citation of all of the articles published or to a high degree of citation of only some articles. Second, multidisciplinary journals usually have a higher IF than specialized journals. Third, there are differences between research fields, including in research intensity. The highest ranking journal in each specialized field may have a very different IF from speciality to speciality. Fourth, the types of articles published by a journal also influence its IF. Review articles and technical reports are more frequently quoted than original research articles, case reports, and pictorial essays.

b) Normalized Journal Impact Factor: This indicator corresponds to the relative number of citations to publications in one specific journal, compared to the world average of citations to

publications of the same document type, age and subject area. The indicator is stated as a decimal number that shows the relation of the number of citations to the world average. As an example, 0.9 means that publications in this journal are cited 10% below average and 1.2 that they are cited
20% above average.

c) Immediacy Index: It is an indicator which measures the current importance of the work published by a journal by calculating the average number of times articles published during a particular year by a specific journal are cited over the course of that same year. The immediacy index is useful for identifying the journals publishing the articles in the emerging areas. It is said that the immediacy index has an unintended bias toward articles published in the earlier part of the year as they would have a better and more chance to get cited than those articles published later in the year.

D) Journal-to-field impact score: The journal-to-field impact score has been proposed by the Center for Science and Technologies Studies of Leiden University (Leiden, the Netherlands) as an alternative to the IF. It measures the average number of cited articles in a specific journal and compares this number with that of other journals in the same research field category. The field categorization of journals is based on the journal subject categories, which are defined by Thomson Reuters. By ranking journals in a given subject category, this score overcomes the limitations of IF related to research field characteristics such as productivity, citation habits, and citation dynamics.

12.6. SUMMARY

Bibliometric and Scientometric analyses are based on many indicators. These indicators seek to measure the quantity and impact of research publications. The indicators are used increasingly in evaluation processes in universities and public and private research institutes. Each of these indicators has its own merits and limitations. Interpreted as exhaustive measures of scientific/research output, the indicators would present a biased story. However, when used with caution, they can reveal some insights through trends regarding aspects of scientific/research production at the global level.

In a conclusion, let us bear in mind the following words of caution given by Durieux and Gevenois (2010) while using the bibliometric and scientometric indicators for analysis: Performance indicators are based on the assumption that the quality of a particular article is reflected by the frequency of its citations in other articles.

- Given differences between fields of research in terms of productivity, citation habits, and citation dynamics, bibliometric indicators should not be used for comparing researchers, research groups, or journals from different fields.
- It is recommended to measure the quality and the impact of scientific journals, research groups, or particular researchers through several indicators rather than only one.

12.7. MCQ QUESTIONS

1. Publication counts indicate the quality of the work of the researcher. False /True

2. h-index has a positive bias toward senior researchers. False /True

3. SCI is published by Thomson Reuters. False /True

4. Impact Factor is calculated for individual or group of researchers. False /True

5. Immediacy index shows the impact of an article for the past decade. False /True

6. Number of references received from other works ______________

7. The indicator developed by J.E. Hirsch as a measure of the scientific productivity of a scientist and the impact of the scientist ___________

8. Giving reference to one's own previous works ___________

9. A measure reflecting the average number of citations to recent articles published in the journal and intended to gauge the importance of a journal in its given field __________

10. An indicator which measures the current importance of the work published by a journal by calculating the average number of times articles published during a particular year by a specific journal are cited over the course of that same year _________

11. Citation analysis ________

12. h-index ___________

13. Crown indicator Center for Science and Technologies Studies at Leiden University

14. Scopus ___________

15. Publication counts ____________

16. Which of the following purpose link analysis used A. Identifying how popular a web site is? B. Which link or web site or page is more popular and why? C. Identifying link relationship across web sites or web pages D. Above all

17. Web Impact Factor (Web-IF) is similar to A. Journal Citation Report (JCR) B. Journal Impact Report C. Research Assessment Exercise (RAE) D. Journal Impact Factor (JIF)

18. Which of the following data gathering programs are used in webometrics A. Web Analyst and SPSS B. Web Analyst and SocSciBot C. Link resolver and Web Analyst D. SocSciBot and Web Analyzer

19. Which of the following Journal was started in 1997 to boost webometrics research A. Informetrics B. Scientometrics C. Cybermetrics D. Webometrics

20. Number of citations is a measure of A. output B. collaboration C. visibility

12.8. SHORT QUESTIONS

What is the h-index?

What is the self-citation of the author?

what is the immediacy index?

12.9. LONG QUESTIONS

What are the limitations of bibliometric analysis?

What is the importance of citation analysis?

KEYWORDS: h-index; self-citation; Immediacy index, Citation

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MCQ ANSWERS

UNIT 1
LIBRAMETRY, BIBLIOMETRICS, SCIENTOMETRICS, INFORMETRICS, ALTMETRICS, AND WEBOMETRICS

1. **C. Hulme, E. W**
2. **A. 1948 at the Aslib's conference Lamington spa**
3. **A. Book or paper**
4. **C. Russian**
5. **D. Otto Nacke**
6. **1940**
7. **1960**
8. **D. Analysis from textual data**
9. **A. Content Analysis**
10. **B. Combination of exponential growth and asymptotic growth**
11. **C. Measuring impact of scholarship in new media**
12. **A. 1976**
13. **an aggregator**
14. **Computer-based approaches in analysis**
15. **A. Tomas Almind and Peter Ingwersen**
16. **D. Measuring the quantitative aspects of web phenomenon**
17. **C. Cybermetrics**
18. **A. papers published in scientific journals**
19. **C. Studying biographies/autobiographies or diaries of library users**
20. **1980**

UNIT 2
LAW OF SCATTERING AND ITS APPLICATIONS

1. **B. Samuel Clement Bradford**
2. **C. F(x) = a + b log x (F(x) is the cumulative # of articles in x most productive journals)**
3. **C. B. C. Vickery**
4. **C. It requires tedious statistical computation**
5. **C. M G Kendall**
6. **A. 1873**
7. **True**
8. **True**
9. **True**
10. **A. 1934**
11. **B. 1968**
12. **C. 1970**
13. **C.043**
14. **A. Leimkuhler's**
15. **B. Scientific**
16. **A. Lotka's law**
17. **C. Lotka's law**
18. **A. Zipf's law**
19. **A. Lotka's law**
20. **False**

UNIT 3
DATA SOURCES AND SOFTWARE TOOLS FOR BIBLIOMETRIC/SCIENTOMETRIC STUDIES

1. **Reference**
2. **Citation**
3. **Citation**
4. **American Chemical Society**
5. **Google Scholar**
6. **LISA**
7. **Thomson Reuters**
8. **Tenurometer**
9. **Hirsch**
10. **Publish or Perish**
11. **B. Citation database**
12. **B. Elsevier**
13. **C. J.E. Hirsch**
14. **B. Visualization Software for large networks**
15. **A. Search engine for scholarly literature**
16. **A. Olle Persson**
17. **B. 2010**
18. **D. Eugene Garfield**
19. **shiny app providing a web interface for bibliometrix**
20. **freely available Java application for visualizing and analyzing trends and patterns in the scientific literature**

UNIT 4
BIBLIOMETRICS IN ASSESSING PRODUCTIVITY AND IMPACT OF RESEARCH

1. **A. 1873**
2. **B. E. Garfield**
3. **A. The research output of an institution**
4. **D. Hirsch**
5. **B. Impact Factor of Journals**
6. **B. 2**
7. **D. Actual citations received by papers from a particular country to the expected number of citations**
8. **True**
9. **False**
10. **True**
11. **Self-citation**
12. **Impact factor**
13. **Immediacy indicator**
14. **Center for Science and Technologies Studies at Leiden University**
15. **Elsevier**
16. **Quantity indicator**
17. **National**
18. **C. Directory of periodicals accessible online in full-text**
19. **C. Scopus**
20. **A. Articles**

UNIT 5

DIFFERENT MODELS TO EXPLAIN THE PHENOMENA OF GROWTH AND OBSOLESCENCE OF LITERATURE

1. **C. Exponential Model**
2. **C. Exponential Model**
3. **D. Logistic Model**
4. **B. Scientific literature grow exponentially**
5. **C. Science Temper**
6. **False**
7. **True**
8. **False**
9. **True**
10. **True**
11. **Exponentially, Normal Distribution, Logistic Curve**
12. **Varies with time, Fixed, Constant**
13. **Growth Rate, Obsolescence, Half Life**
14. **A. Productivity of a research unit**
15. **False**
16. **International**
17. **USA**
18. **A. Growing steadily**
19. **B. is field dependent**
20. **B. differs from one country to another country**

UNIT 6

OBSOLESCENCE FACTOR

1. **B. Decreasing value of the product** 2. **A. Set of references at a single point of time**
3. **B. Set of references/ citations of a subject from the begininning to the end**
4. **To what extent they can go back to obtain the required published information in their particular field of interest** 5. **A. Through plotted data on semi-log graph**
6. **B. Latin**
7. **C. Higher the half-life** 8. **True**
9. **False**
10. **By which the active life of article in Periodicals appears to decay**
11. **Factor by which the active life of an individual Article on a set of documents tends to delay annually**
12. **Half the use of total individual articles in a Document**
13. **Ratio of percentage of documents use/nonuse in**
14. **False**
15. **True**
16. **Growth Rate, Obsolescence, Half Life**
17. **A. papers published in scientific journals**
18. **B. output**
19. **C. standing of a journal**
20. **A. Number of citations/ number of papers**

UNIT 7

CITATION ANALYSIS

1. **A. Integrated Online Indicators**
2. **Another discipline**
3. **Citation window**
4. **Bibliographically coupled**
5. **Science Citation Index**
6. **A. the influence of the research output**
7. **B. low citation rate**
8. **C. higher citation rate**
9. **A. less frequently**
10. **Field dependent**
11. **B. Co-citation**
12. **True**
13. **False**
14. **False**
15. **True**
16. **True**
17. **Self-citation**
18. **D. Actual citations received by papers from a particular country to the expected number of citations**
19. **Thomson Reuters**
20. **D. Web of Science**

UNIT 8
SCIENCE INDICATORS

1. **D. All types of indicators**
2. **A. Productivity of a research unit**
3. **B. A strategic research area**
4. **True**
5. **True**
6. **False**
7. **False**
8. **True**
9. **True**
10. **papers influence**
11. **Papers of high value**
12. **Top ranked journals Reflect potential impact of a paper**
13. **non-influential work**
14. **D. Novelty, non-obvious and utility clause**
15. **A. Productivity of a research unit**
16. **B. A strategic research area**
17. **A. Integrated Online Indicators**
18. **A. Collection depth indicators**
19. **Data field separator**
20. **False**

UNIT 9
NATIONAL MAPPING OF SCIENCE

1. **Hirsh**

2. **Thomson Reuters**
3. **Journal Citation Reports**
4. **Elsevier**
5. **Scientific performance**
6. **A. papers published in scientific journals**
7. **B. output**
8. **C. visibility**
9. **C. standing of a journal**
10. **A. Number of citations/ number of papers**
11. **False**
12. **False**
13. **True**
14. **True**
15. **True**
16. **False**
17. **False**
18. **Citation**
19**. Impact factor**
20. **Immediacy indicator**

UNIT 10

COLLABORATIONS IN SCIENCE

1. **Local, domestic and international**
2. **Local**
3.. **Domestic**
4. **International**
5. **USA**
6. **A. Growing steadily**
7. **B. is field dependent**.
8. **B. differs from one country to another country**.
9. **A. more citations**
10. **A. Ajiferuke**
11. **False**
12. **False**
13. **True**
14. **True**
15. **True**
16. **A. the influence of the research output**
17. **B. Co-citation**
18. **D. Can be applied in studying co-authorship collaboration**
19. **suggested Degree of Collaboration**
20. **Co-authorship Index**

UNIT 11

SCIENTOMETRIC STUDIES AND THEIR ROLE IN SCIENCE POLICY

1. **D. Analysis from textual data**
2. **A. Content Analysis**
3. **B. Combination of exponential growth and asymptotic growth**
4. **True**

5. **False**
6. **True**
7. **False**
8. **True**
9. **True**
10. **False**
11. **growth of scientific knowledge, signaling new areas of research**
12. **mapping the cognitive structure of scientific knowledge**
13. **assessment of scientific research**
14. **future studies**
15. **A. 1873**
16. **B. E. Garfield**
17. **A. The research output of an institution**
18. **B. Samuel Clement Bradford**
19. **A. Lotka's law**
20. **C. Statistician**

UNIT 12
CHALLENGES OF BIBLIOMETRIC AND SCIENTOMETRIC STUDIES

1. **False**
2. **True**
3. **True**
4. **False**
5. **False**
6. **Citation**
7.. **H-index**
8. **Self-citation**
9. **Impact factor**
10. **Immediacy indicator**
11. **Eugene Garfield**
12. **Jorge E. Hirsch**
13. **Center for Science and Technologies Studies at Leiden University**
14. **Elsevier**
15. **Quantity indicator**
16. **D. Above all**
17. **B. Web Analyst and SocSciBot D. Journal Impact Factor (JIF)**
18. **B. Web Analyst and SocSciBot**
19. **C. Cybermetrics**
20. **C. visibility**