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Scholarly Research on Serendipitous Retrieval of Information (Information Encountering): A Bibliometric Analysis of Literature Indexed in Scopus

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Abstract

The purpose of this paper was to map literature on accidental discovery (information encountering), and present its quantitative analysis. To achieve the purpose of the study, data from Scopus database was used. Productivity and quality of top authors, institutions and countries was investigated. Additionally, top journals and their selection by top authors was also investigated. Findings of the study indicated that the term, theory, and model of information encountering originated from the USA, and was later spilled across the world. The USA remained the most cited and most impactful country. American scholar Erdelez, who was affiliated with the University of Missouri, remained the most prolific author. Journal of Documentation is the top publication which accommodates   studies related to the concept of information encountering. The study has implications for researchers, research organizations, and the countries interested in exploring the field of information encountering.

Keywords: Bibliometric analysis, Scopus, Literature analysis, Information Encountering, Serendipitous retrieval of information, opportunistic discovery of information.

Introduction

Horace Walpole, an art critic, English author, and politician coined the term serendipity in 1854. It is known as an act of making accidental discoveries of things which one is not on quest for (Andel, 1994; Erdelez, 1995; Foster & Allen, 2014). It also involves a chance observation, and is considered a fortune discovery. The outcome is relevant to the past needs in most of the cases(Rubin, Burkell, & Quan-Haase, 2011). It is a general and broad term involving discoveries in all walks of life, e.g., invention of the Tyflon medicine, and of America by Columbus. However, when researchers talked about serendipitous discovery of

information, they named it Information Encountering (IE) (Erdelez, 1995; Erdelez & Makri, 2020). Erdelez (1995) coined the term IE in her doctoral work. She defined it as:

> "a form of information acquisition that is not planned or anticipated. It is characterized by users' low involvement or no involvement in looking for information that was acquired, and by a low expectation or no expectation that such information will be acquired (p. 3).

Her doctoral dissertation was a breakthrough and the IE emerged as an area of interest for the researchers of library and information sciences. So far, three doctoral dissertations have been made on it(Awan, 2021; Erdelez, 1995; Lu, 2012). This IE has been termed by other researchers as serendipitous retrieval of information (de Bruijn & Spence, 2008; Hopkins & Zavalina, 2019); and opportunistic discovery of information, and information encountering (Irvine-Smith; Pálsdóttir, 2011).

The investigation of this area has grabbed   attention of researchers who have extensively investigated its various aspects including the assessment of visual stimuli that triggers information encountering (Jiang, Gao, Xu, Fu 2019); disruption created by the accidental exposure to information (Makri and Buckley, 2020); the sharing behavioral patterns of the encountered information (Awan, Ameen and Soroya 2019; Panahi, Watson and Partridge 2016); management and keeping related prospects of information encountering (Stewart and Basic 2014; Awan, Ameen and Soroya, 2020); and information encountering behaviors in interlinked online web environments (Erdelez, 1996; Erdelez, 2000; Awamura, 2006; Miwa, Egusa, Saito, Takaku, Terai and Kando, 2011). However, the aspect of the impact created by all these studies on the serendipitous retrieval of information/ information encountering remained a literature gap, and has never been investigated.

The previously published literature indicates that the bibliometric analysis techniques suited the most in measuring the impacts created by the literature, and for furnishing

suggestions for research related improvements (Ellegaard & Wallin, 2015; López-Muñoz, Boya, & Alamo, 2006). It comprises three types of indicators: quantity indicators (which measure productivity of researchers, organizations, journals etc.), quality indicators (which measure "performance" of a researcher's output, and the structural indicators (which measure connections between publications, authors, and areas of research).

Therefore, the present study has been comprehensively designed to identify the quantity (number of articles produced by top authors, organizations, and countries); impact (in the form of citations secured by authors, organizations, and countries); and structure (authors, countries, and sources of information they have published in; and the research trends via keyword analysis)of the studies conducted on the information encountering, and indexed in the Scopus database. The analysis covers an array of the following research questions put to meet objectives of the study:

RQ1: What are the frequencies of documents (types), authors, and citations of the documents?

RQ2: What is the number of publications per year and their publication pattern?

RQ3: What are the citations patterns of the documents on yearly basis?

RQ4: Who are the most prolific authors related to the concept of information encountering?

RQ5: What are the year-wise dynamics of source publishing on information encountering?

RQ6: What are the author supplied keywords/ associated research trends with the phenomenon of serendipitous retrieval of information?

RQ7: Which organization basically developed the concept of information encountering?

RQ8: Which countries contributed, and how much did they contribute in the growth of the concept of information encountering?

RQ9: Which countries, and how much impact did they create to the knowledge base of information encountering?

RQ10: Which authors from which institutions and geographic area remained the most productive?

RQ11: Which authors from which geographic location published in which information sources?

Literature review and theoretical framework

Bibliometric analysis technique is quite popular among researchers in the field of library and information management. Its analysis represents the status regarding books, journals, scientific articles and authors (Ngulube, 2019). The technique has been used in a large number of researchers e.g. in bibliometric analyses of journal (Mokhtari, Barkhan, Haseli, & Saberi, 2021); countries' productivity (Salisu & Salami, 2020); and bibliometric analyses of different phenomena (Iqbal et al., 2019; Patyal, Jaspal, & Khare, 2020; Ram & Paul Anbu K, 2014; Sahoo & Pandey, 2020). However, the impact created by the phenomenon of serendipitous retrieval of information has never been investigated so far.

Glänzel, Moed, Schmoch, and Thelwall (2019) opined that peer review and bibliometric analysis are the best for evaluating and monitoring literature. It is an important method and provides with the consistent set of indicators and maps of the literature. It provides with a reliable, transparent, and objective assessment of performance. Researchers

previously did the bibliometric analysis of different domains in the field of library and information management, and checked the impact created by analyzing Scopus database. The analyses of the information sources indexed in the Scopus are also done in the areas of mobile information literacy (Pinto et al., 2019), information literacy literature (Koos, 2019), e-government (Dias, 2019), computer networking & computer science (Bakri & Willett, 2011; Iqbal et al., 2019), plagiarism (Chauhan, 2018; García-Romero & Estrada-Lorenzo, 2014), and different research designs adopted by the researcher (Chai & Xiao, 2012). The researchers remarked that their bibliometric studies were useful in understanding and exploring quality of the literature. The patterns for writing, methods and techniques for analysis and representation for the present study were reviewed in the above-mentioned literature.

Procedures: research design & methodologies, data quality

The study aimed at identifying the bibliographic patterns of the studies published on the concept of information encountering. The data for this objective was retrieved from Scopus database. Previously researchers have also analyzed the data from Scopus. They remarked that the data is highly authentic for bibliometric analysis(Ahmad, Jian Ming, & Rafi, 2018).

Search query

The literature review being done for this study indicated that four phrases were interchangeably used for accidental exposures to information i.e. i) opportunistic discovery of information ii) serendipitous retrieval of information, iii) accidental discovery of information and iv) information encountering. An advanced search query was phrased in the Scopus databases to retrieve the items containing all of these terms and phrases in the topics of the items. All these terms were searched through Boolean operator "or" among all the searched

phrases. The items' indexed time was not specified and those indexed during all the times were retrieved. The devised search query is as follows:
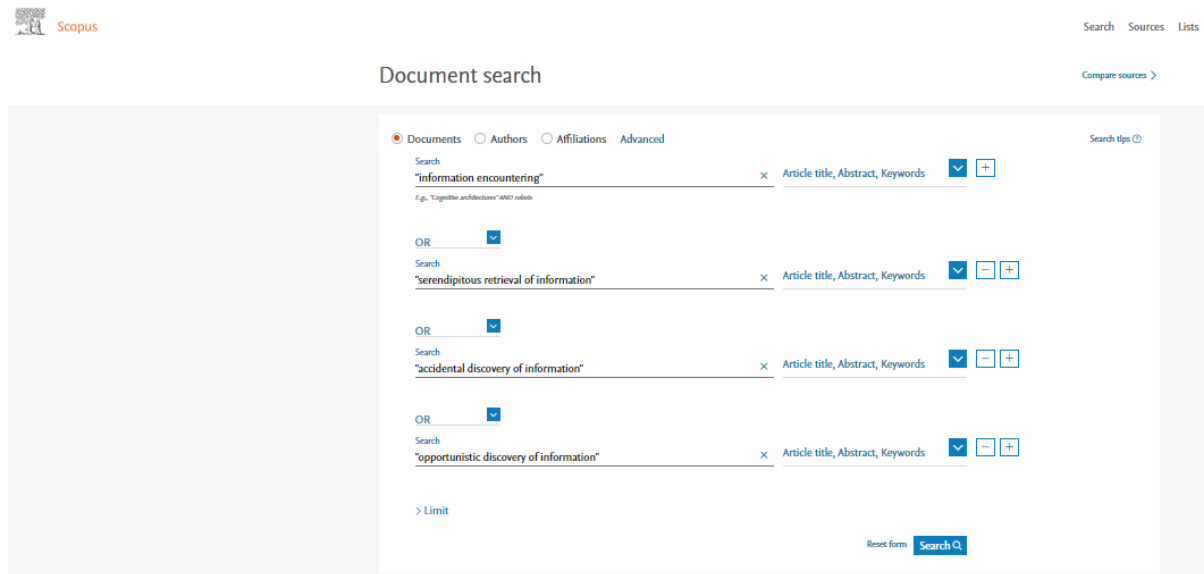

Figure 1 Scopus query and the search interface used for the present study

Data Analysis

The data was downloaded in RIS, BibteX, and CSV format. The duplication was checked by opening the RIS file in Endnote software. The software provides an option of tracing duplicate entries. CSV file was used for analysis in different programs including VosViewer, and R Studio. The bibliometric application within the R Studio was used for the data analysis.

Findings

The analysis of the literature related to the accidental discovery of information revealed some important insights, which are as follows:

RQ1: What are the frequencies of documents (types), authors, and citations of the documents?

Table 1

Main Information About the Data

Description	Results
Timespan	1999:2020
Sources (Journals, Books, etc.)	30
Documents	68
Average citations per documents	10.97
Average citations per year per doc	1.076
Documents Type	
Article	44
Conference paper	21
Editorial	1
Review	2
Authors	
Authors	125
Author Appearances	181
Authors of single-authored documents	15
Authors of multi-authored documents	110

Table 1 shows the main information about the data. The articles retrieved were not delimited to the time frame. The first ever article indexed in Scopus was published in 1999. Therefore, the data from 1999 to 2020 were retrieved and analysed. In toto, 68 documents were retrieved from the 30 sources (Journals, Books, etc.). The largest number of the documents were in the shape of articles (N = 44). Conference papers were the second largest number retrieved (N = 21). Two reviews and one editorial were retrieved from the database which focused on the information encountering concept. Each document secured an average total 11 citations during the time span of (1999 - 2020). In total 125 authors have worked on the concept of IE so far. They have authored 110 multi-authored documents.

RQ2: What is the number of publications per year and their publication pattern?

The Figure 2 shows the publishing patterns related to the concept of IE in the Scopus database year wise. The first ever document appeared in the year 1999 in the Scopus database.
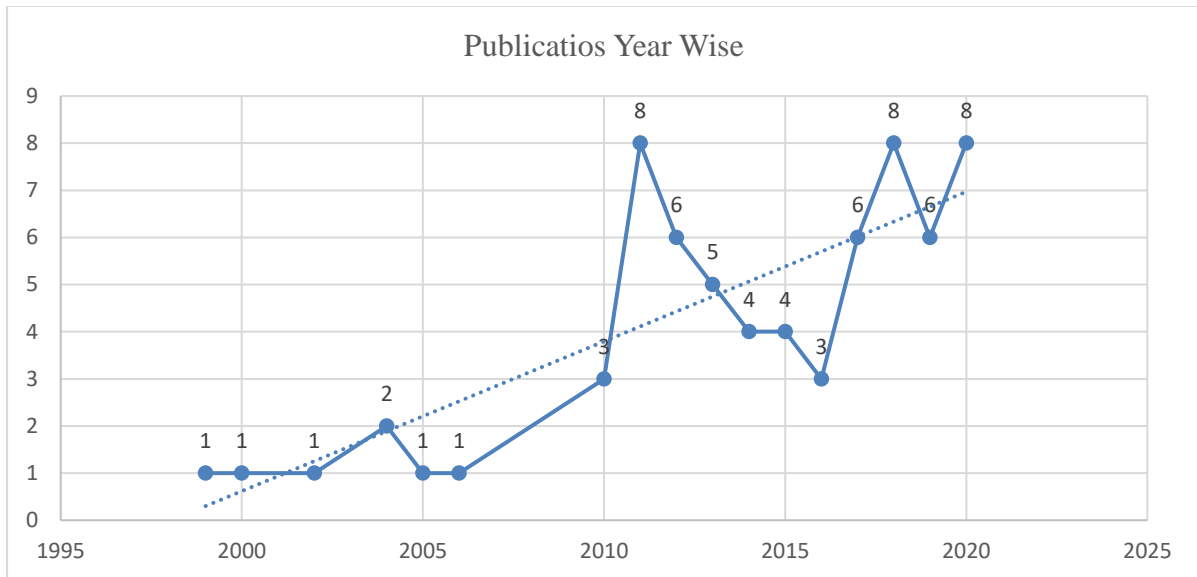

Figure 2 Publication pattern per year

The linear representation shows that after its first appearance, it kept continuously spreading. The trend of publishing on serendipitous retrieval of information has continuously been on the rise till 2020. This rise in the research productivity made 2011,2018 and 2020 the highly productive years (securing 8 publications each).

RQ3: What are the citation patterns of the documents on yearly basis?
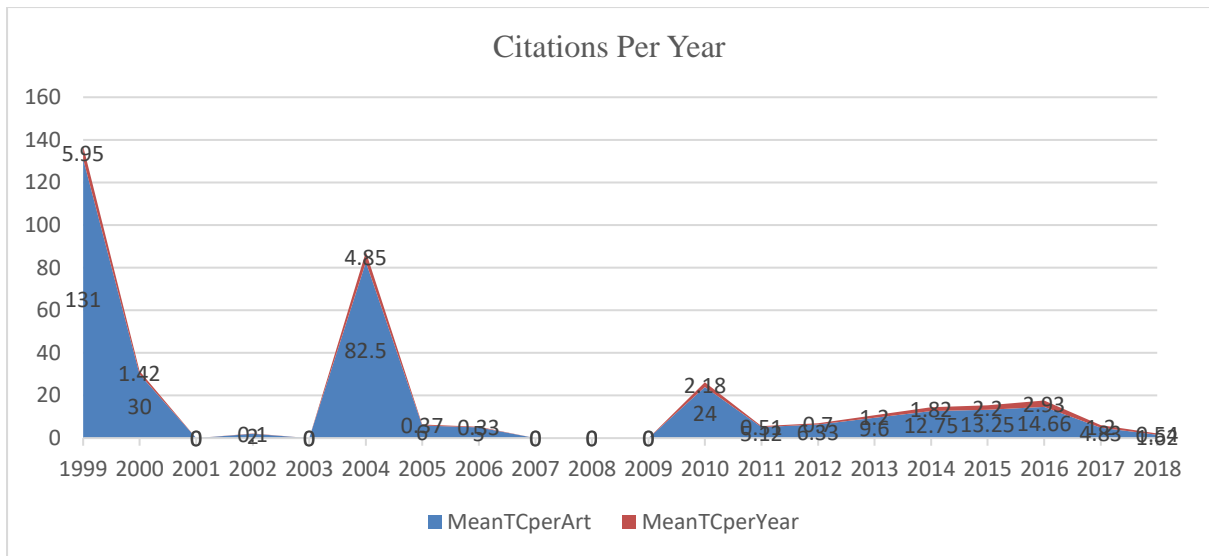
Figure 3 Citations year wise

Figure 3 indicates the citation patterns of the studies. It indicates that the citations patterns are bound to the large number of citable years. The year 1999 is the highest in the graph while the years 2009; 2008; 2007; 2003; and 2001 the lowest as they were found "empty". The peak point during the year 1999 secured 131 total citations (5.95 per year). The second largest citable year was 2004, securing a total 82.5, and per year 4.85 citations.

RQ4: Who are the most prolific authors related to the concept of information encountering?

While doing the citation analysis keeping authors as units of analysis, minimum number of documents of an author and citations were selected to 1. In all, 107 authors appeared to have met the criteria. The following graph presents the analysis:
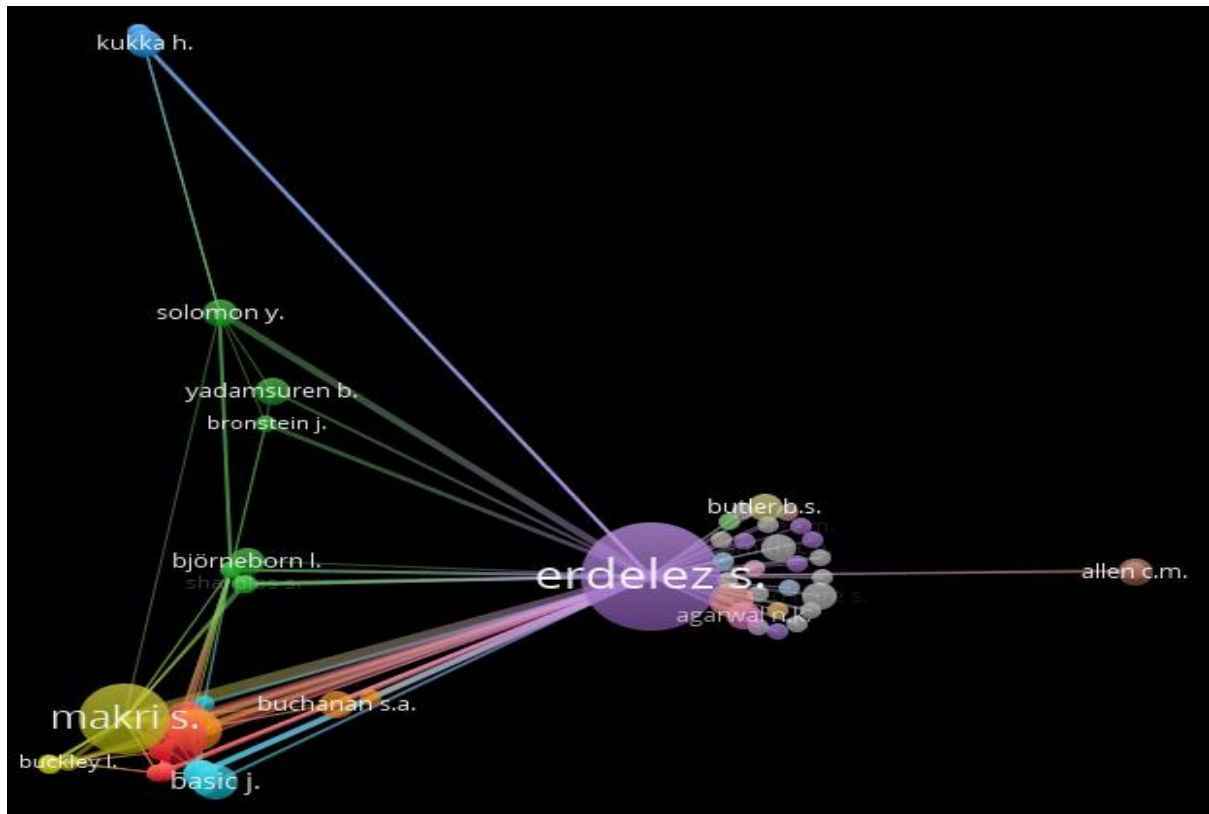
Figure 4 The Map of the Most Prominent Authors

Figure 4 shows that Erdelez had the honor of publishing most documents (N = 18), and she also secured the largest number of citations (N = 328). Makri happened to be the second largest cited author by publishing nine documents getting 54 citations, followed by Jiang, publishing five documents getting 29 citations.

RQ5: What are the dynamics of source publishing on information encountering year wise?
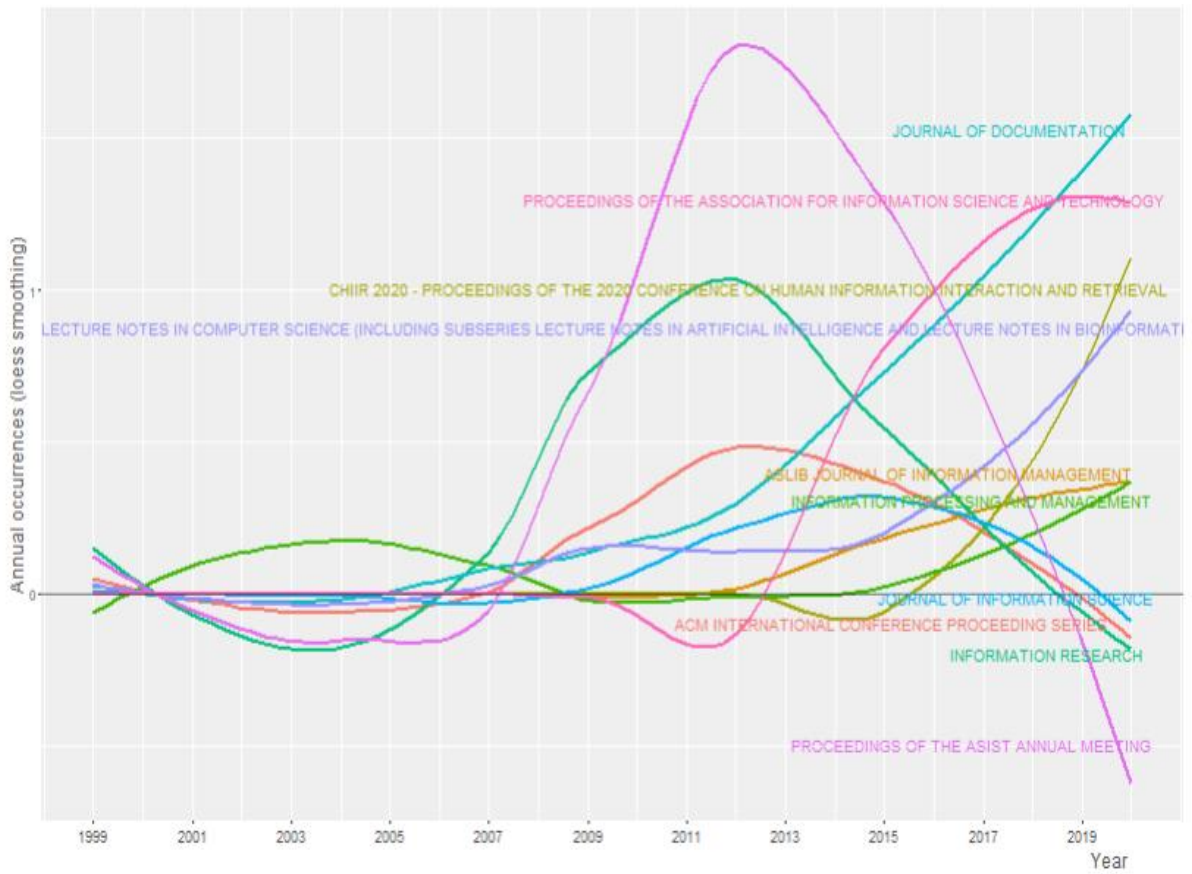

Figure 5 Source dynamics year wise

Figure 5 indicates that the Journal of Documentation was on the top in the year 2020. The journal published the first paper related to the information encountering in 2006. Afterwards it kept the pace till 2020 at its peak. In between the top journal and the second, there were three conference proceedings. Aslib Journal of Information Management appeared at number two. It was followed by the Information Processing and Management. It is quite common to present the newly discovered phenomenon in conferences. Later, the research on it is conducted and published in journals. The information encountering was also presented in conferences and published in their proceedings, especially Proceedings of the Association for

Information Science and Technology and CHIR – 2020 – Proceedings of the 2020 Conference on Human Information Interaction and Retrieval.

RQ6: What are the author-supplied keywords/ associated research trends with the phenomenon of serendipitous retrieval of information?

Keyword co-occurrences are interesting because they reveal a lot about the studied phenomena e.g. methods used, associated fields of study, and research trends etc. Therefore, the co-occurrences of the keywords were checked. While doing so, the number of occurrences of the keywords was set to at least two repetitions. Out of the total 183 keywords supplied by the authors, 25 met the threshold. The heat map generated from the keywords is as follows:
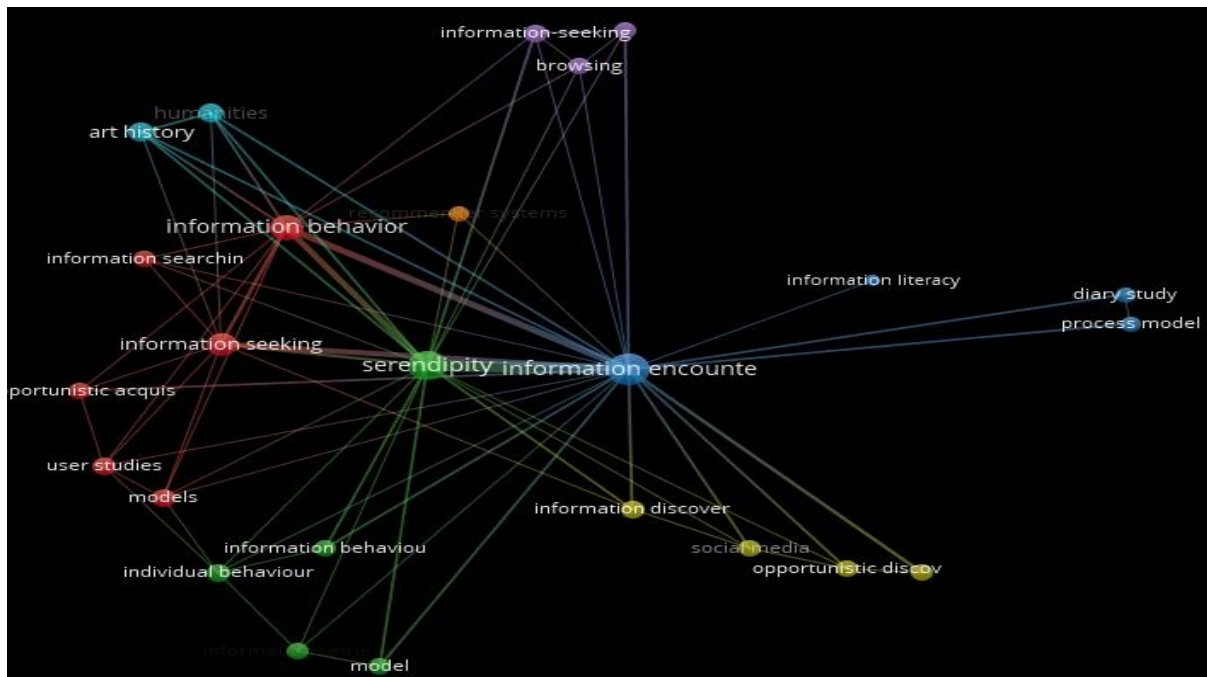

Figure 6 The Map of Author Supplied Keywords

The most repeated author keyword was "information encountering" having 40 co-occurrences followed by serendipity having 18 co-occurrences, and then information behavior having 11 co-occurrences. Additionally, the heat map indicates that the concept of

information encountering is also closely associated with information seeking, information behavior, and individual behavior. Browsing and social media are also closely related to the concept of information encountering.

RQ7: Which organization took most part in growing the concept of information encountering?

While conducting the citation analysis, the organizations were kept as units of analysis. Those which produced merely one document and secured one citation were selected for the analysis. Out of the total enlisted 116 organizations which had worked in the area of information encountering, 86 met the threshold. This number was analyzed to generate the heatmap that is presented as follows:
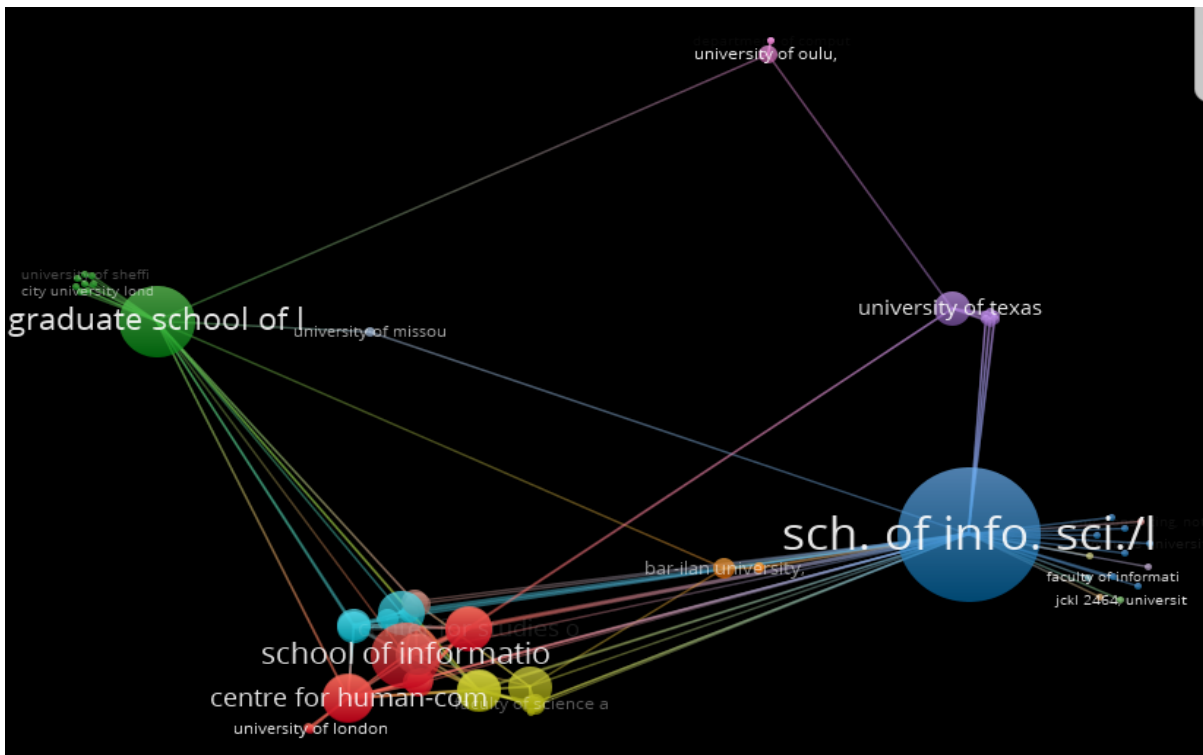

Figure 7 The Map of Citations and Organizations of the Authors

The Graduate School of Library and Information Sciences, University of Texas, Austin secured the largest number of citations (N = 131) followed by the School of Information Science/ Learning, University of Missouri (N = 94). The organization which

secured the third largest number of citations was Fx Palo Alto Laboratory at Hillview Avenue (N = 71)

RQ8: Which countries contributed in the growth of the concept of information encountering, and how much?
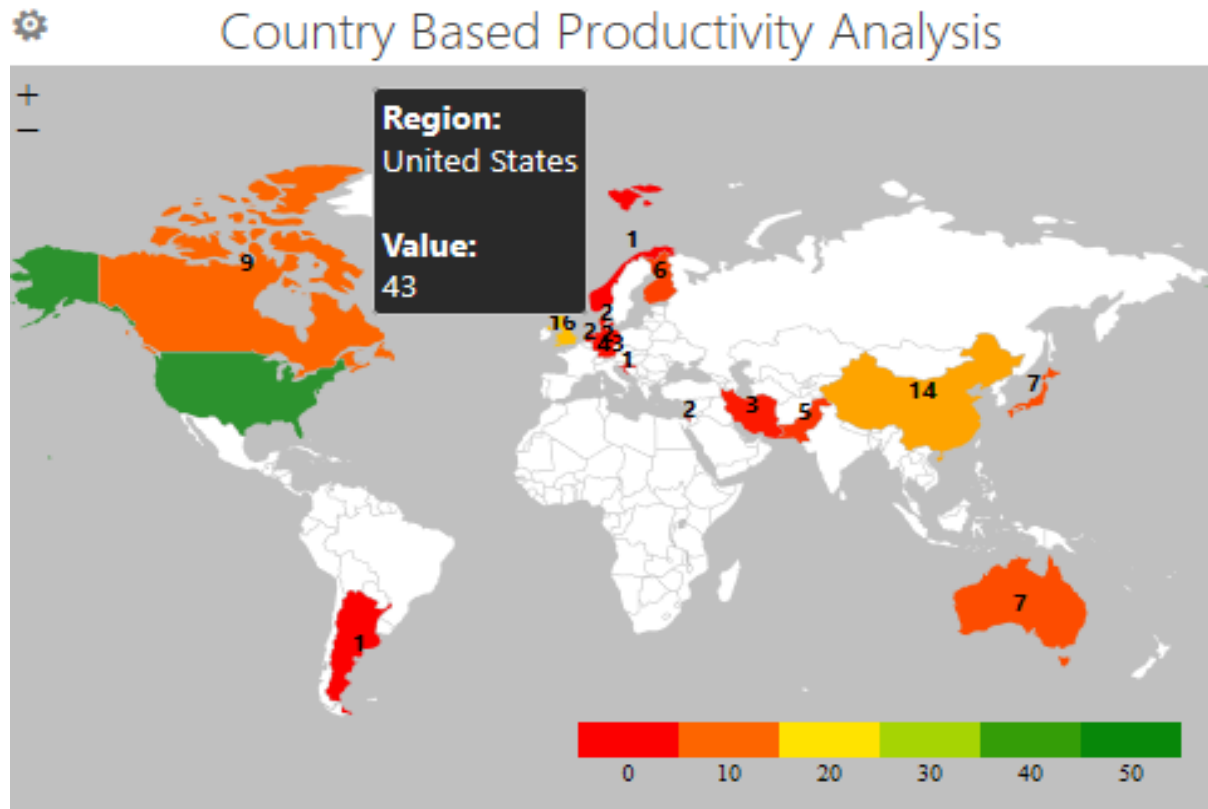

Figure 8 Countries' share in research production

The United States of America leads the Scopus indexing. The highest number of documents related to the serendipitous retrieval of information were produced from the geographic area of the United States of America (N = 43), followed by United Kingdom (N =16). China has produced 14 documents so far.

RQ9: Which countries impact the knowledge base related to the phenomenon of information encountering, and how much?
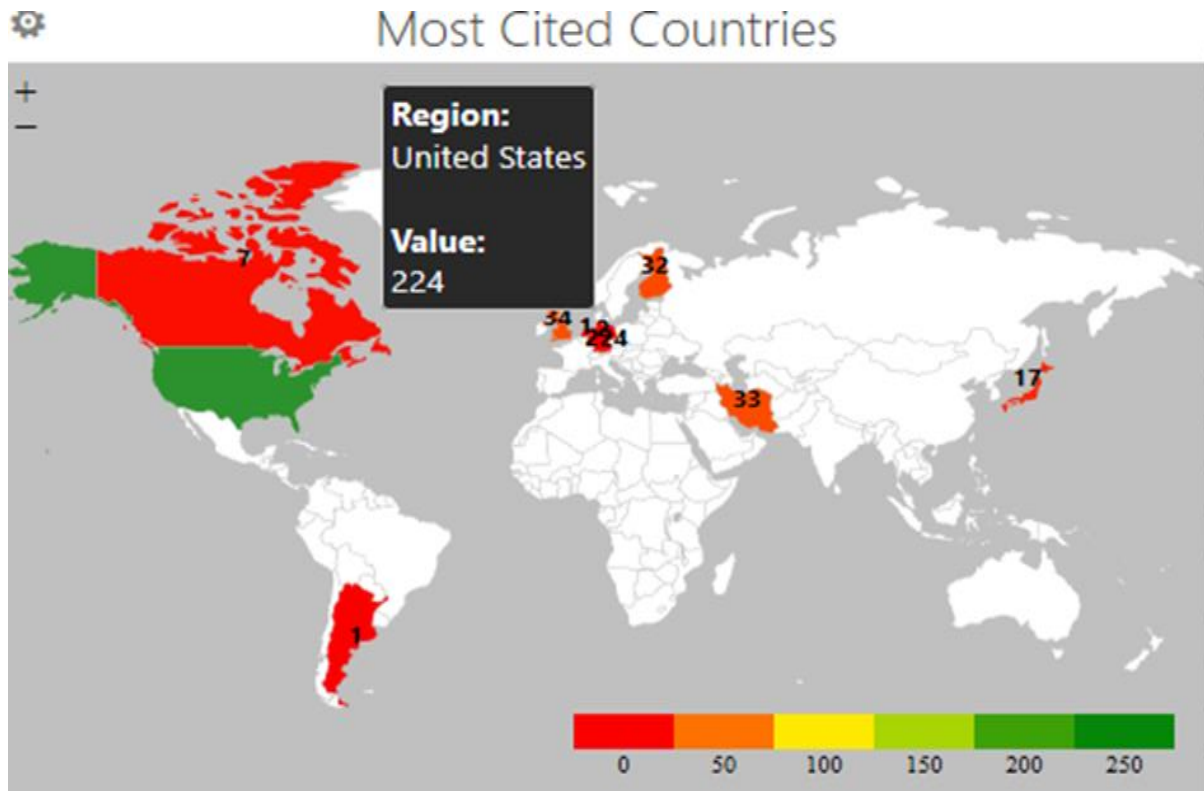
Figure 9 Countries' share in Research Impact (citations)

Figure 9 shows the total impact created by the countries in the form of citations. The USA created maximum impact and its knowledge production was cited 224 times out of the total 390 citations in the world. Iceland remained second in creating the knowledge impact and its knowledge base was cited 39 times. Third was the United Kingdom in creating impact and its works were cited 34 times across the world. Average citations per article remained 22.4 for the United States of America, 19.5 for the Iceland, and 8.5 for the United Kingdom.

RQ10: Which authors from which institutions and geographic area remained the most productive?

To know that which authors from which institutions and geographic area remained the most prolific, a three-dimensional graph was generated. The dimensions are as follows:
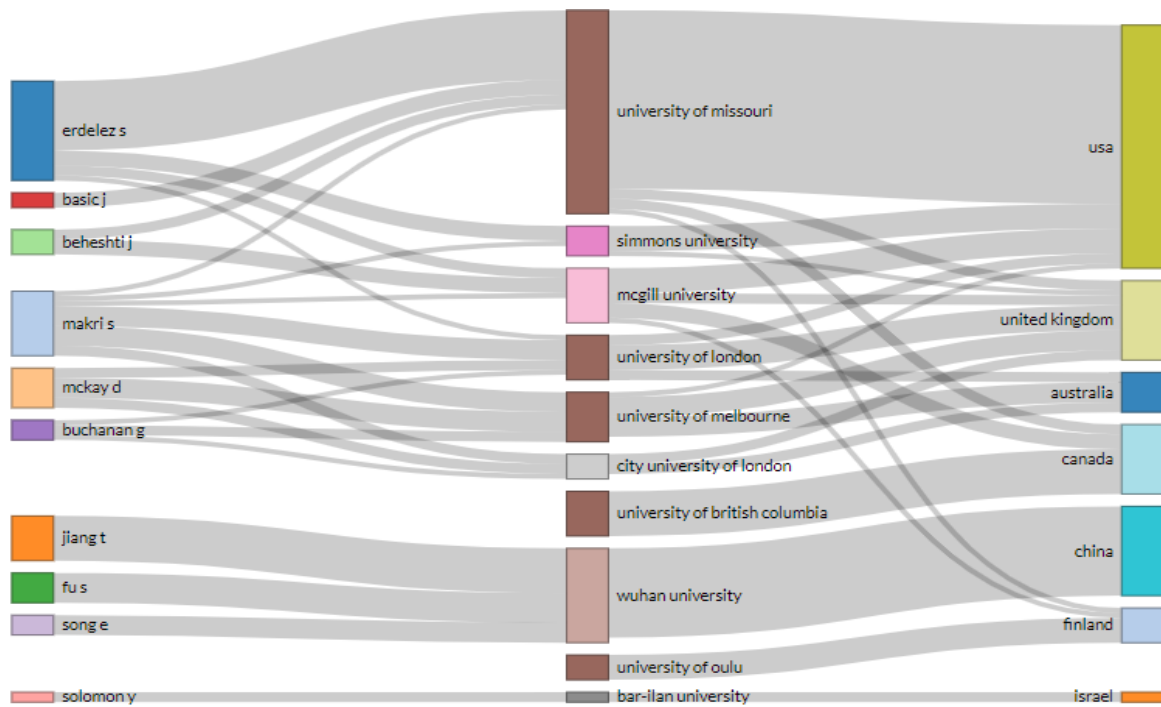
Figure 10 Three-Dimensional Representation of Authors, their Affiliated Organizations and
Countries

The three-dimensional graph indicates that the major role was of Erdelez in making
the United States of America the most productive country. The scholar had coined the term of
information encountering (Erdelez, 1995), and later gave a model of information
encountering in (Erdelez, 2005). She mainly remained associated with the University of
Missouri, making it the y most productive institution. She also wrote on information
encountering during her days with Simmons University and McGill University. All this made
her the most prolific author in the field of serendipitous retrieval of information. Makri,
affiliated with the University of London, and City University of London remained the second
most prolific author in the realm of information encountering. He made United Kingdom the
second most productive geographic area with regards to the research in the field of
information encountering. Jiang belonged to China, and she remained the third most prolific
author. She solely remained affiliated with the Wuhan University China, and never worked in
coordination with any other university, or country.

RQ11: Which authors from which geographic location published in which information sources?

To know the information sources in which the prolific authors have been publishing, a three-dimensional graph was generated. The following graph shows in three columns the authors connected to the journal in which they were published. The graph also indicates the authors' countries and the origin of the journals in which their work was published.
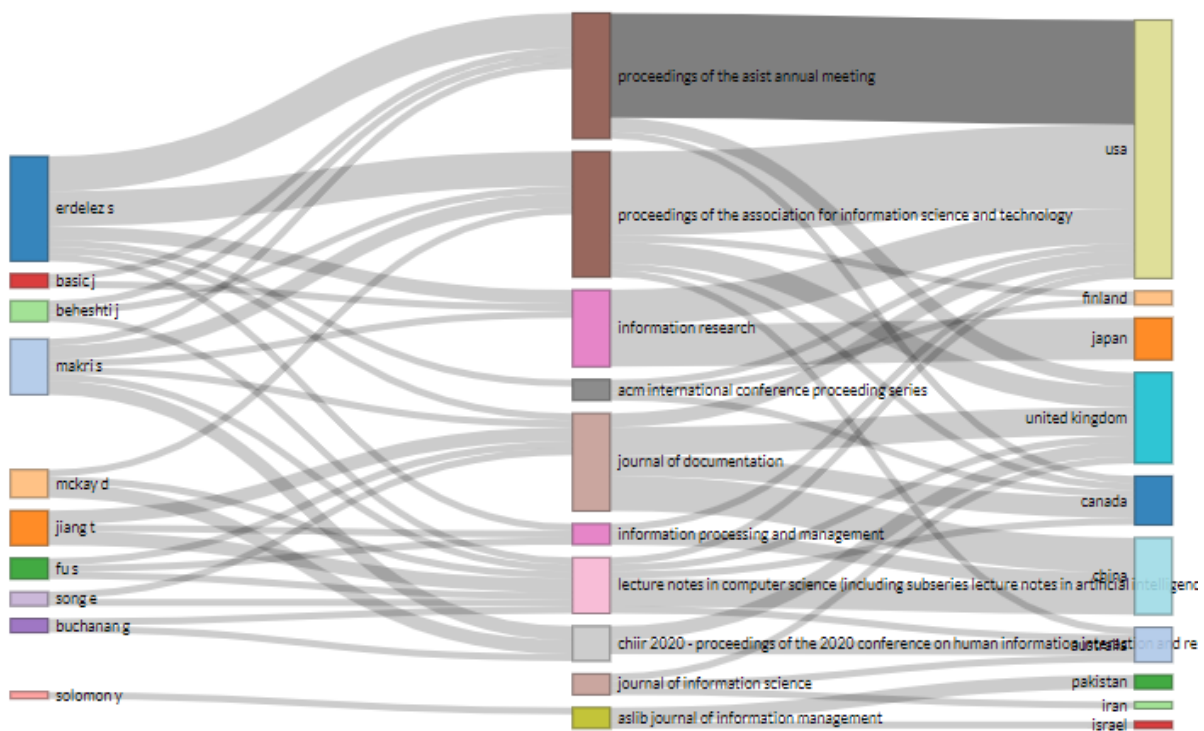

Figure 11 Three-Dimensional Representation of Authors, their Affiliated Countries and Published in Information Sources

Erdlez, the most prolific US author, was   mostly published in the Proceedings of the Association for Information Science and Technology Annual Meeting. However, she has also been published in Information Research, ACM International Conference Proceeding Series, Journal of Documentation, Information Processing and Management. Makri, the second most prolific author got published most of his work in the Proceedings of the Association for

Information Science and Technology Annual Meeting Proceedings, CHIIR 2020 Proceedings of the 2020 Conference on Human Information Interaction and Retrieval, and in Lecture Notes in Computer Science. He was also published in Information Research and Journal of Documentation. Chinese author Jiang was also published in the Lecture Notes in Computer Science. The research journals in which she was published were Journal of Documentation, Information Processing and Management. Recently, the Journal of Information Science and Aslib Journal of Information Management also have started publishing the studies related to the information encountering.

Discussion

The phenomenon of information encountering was revealed (Erdelez, 1995) and put under the umbrella of information behaviors(Wilson, 2000).Erdelez (2005) gave a five-step model of information encountering. Later, Awamura (2006) extended the model of information encountering in the Japanese context through qualitative approach. The extended model was checked through quantitative approach in the Pakistani context and found the same (Awan, 2021; Awan, Ameen, & Soroya, 2019). A later study again reshaped the model on information encountering by adding in the general browsing at starting point for the process of information encountering (Awan, Ameen, & Soroya, 2020). Previously it was assumed that the information user will serendipitously encounter the information while working on a foreground information task only. The reshaped model of IE is as follows:
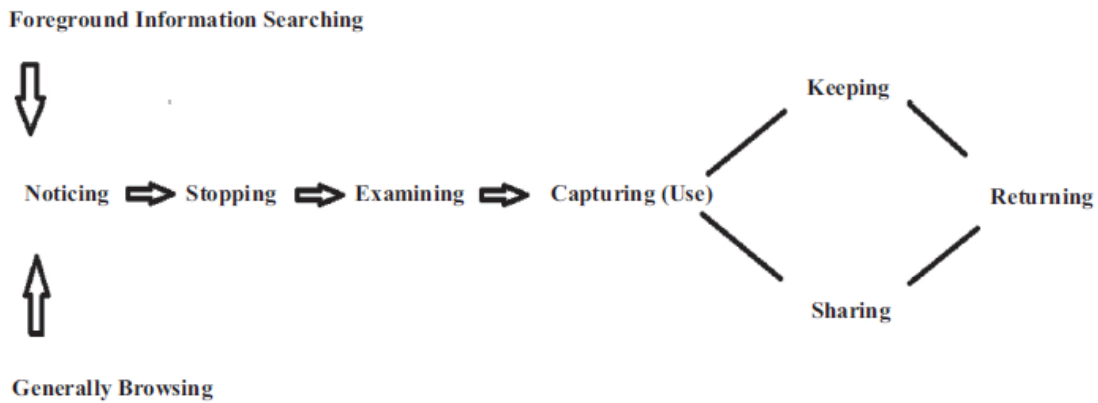
Figure 12 Reshaped Model of Information Encountering Original Source (Awan et al., 2020)

The bibliometric analysis of literature related to the serendipitous retrieval of information revealed some significant insight related to the publishing trends; the prominent authors; productive institutions; and the countries' role in creating impact. The major findings creating the significant contribution to the knowledge are as follows:

The information encountering has gained popularity among the researchers since the doctoral of Erdelez in 1995. However, the related first document did appear in Scopus in 1999. Till 2020, 68 information encountering related documents are indexed in the Scopus database. The largest number of document type are articles (N = 44), followed by conference papers (N = 21). One IE related editorial and two review papers were also found in the database. Since its emergence, the number of the published documents in the Scopus is continuously growing. While discussing the productivity related to the serendipitous retrieval of information, the USA remained the most productive country by document number (N = 43). The largest number of documents were also from the USA-based university i.e. University of Missouri (N = 19). The USA created the most prominent knowledge impact which can be observed in the following figure:
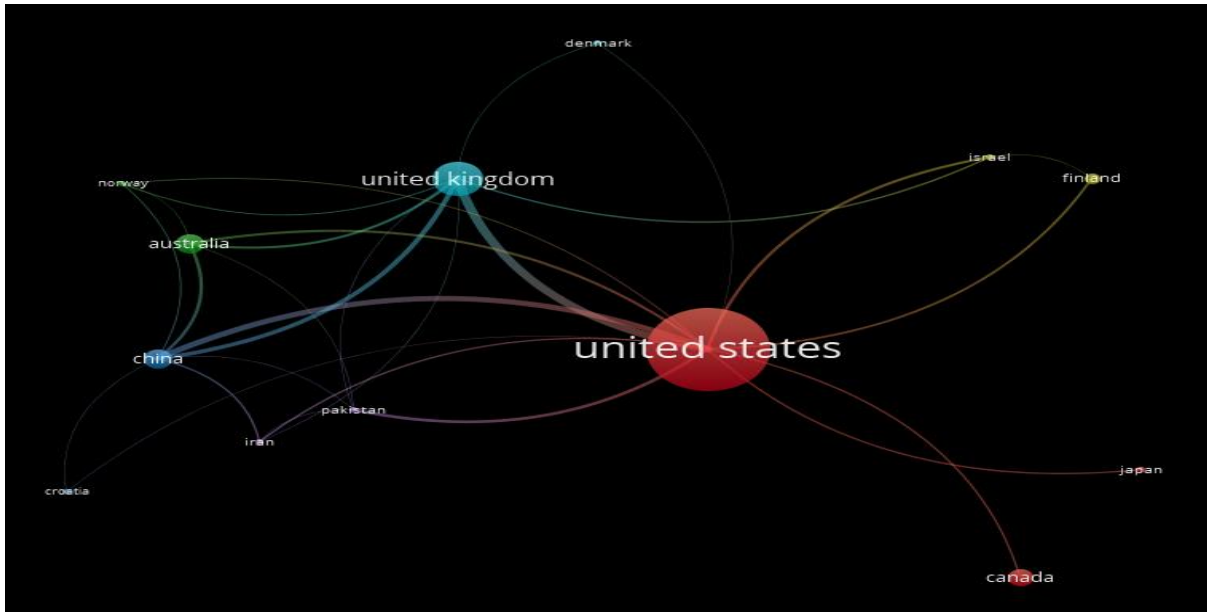
Figure 13 Citations Metrics of the Countries

Figure 13 indicates that among all the documents published from different geographic locations, the USA remained the most prominent country that impacted the nations working on information encountering. The 29 citable documents from the USA were cited 455 times in total (citations within articles counted). Previous researchers also were of the view that the American authors are producing a majority of overall LIS literature (43%) e.g. (Ahmad, Sheikh, & Rafi, 2019; Jabeen et al., 2015; Jabeen et al., 2016) etc. Ahmad et al. (2019) remarked that the reason for this high research productivity might be the large number of LIS schools across the USA. The second most productive country was the United Kingdom producing 16 documents, followed by China with 14 documents. China remained the most productive country of Asia Continent.

It is worth mentioning here that there was neither an African origin article, nor was there any African author who has worked on the phenomenon under investigation. This is totally aligned with the results of a previous study by Ahmad et al. (2019). It too could not find any African representation in the top tsen countries in the field of LIS. Keeping in view

the scenario, the African policy makers are advised to   modify their policies to have the pace of their research accelerated.

A probe of the top institutions revealed that the USA based institutions rule the knowledge word related to the serendipitous retrieval of information. The University of Missouri remained on top in the production followed by the Wuhan University of China. This also is an indication of the high impact the USA may be created by dint of its large number of LIS schools , which originally was indicated by Ahmad et al. (2019).

Erdelez from the USA remained the most prolific author both with regard to production and impact. She overall published 18 documents and secured 328 citations. Makri from the UK remained the second most prolific author by publishing 9 documents (half of the Erdelez's), and gained 54 citations. Jiang stood third by publishing five documents and 29 citations. This is the highest number of articles produced by any country or author from Asia. Previously researchers also indicated that the Chinese researchers are top producers in Asia (Mukherjee, 2010).

If the publishing sources are divided into two groups of journals and proceedings, the Journal of Documentation, Aslib Journal of Information Management and Information Processing and Management are the key sources for publishing studies related to information encountering. In the list of conference proceedings, Proceedings of the Association for Information Science and Technology, CHIR 2020 – Proceedings of the 2020 Conference of Human Computer Interactions, and Lecture notes in Computer Science are the sources for publishing the documents related to information encountering.

Conclusions and recommendations

Evaluation of research productivity is extremely important for assessing the growth of a phenomenon being investigated in the course of time. Therefore, the present investigation of serendipitous retrieval of information was made in the light of this very concept. The results of this study have great implications for the countries, institutions, and authors. They show that once originated in the USA, the overall work on the serendipitous retrieval of information has spread across the world. However, regarding the number of publications and citations, the USA still rules the world of research related to it. Likewise, the most productive author is also from the USA. The study concludes that the research production related to the concept on information encountering in continents other than the USA is low. The United Kingdom rules the knowledge world within Europe. Australia also took active part in the research production. China is on number one in Asia. However, not even a single representation was found from the African continent.

In the light of the research analysis and its findings, the researchers have given some suggestions for researchers, research organizations working for improving their research productivity and the country-level research related policy makers. The suggestions are as follows:

o   Researchers from the countries which have not investigated the accidental exposures to the information, must consider working on it. It builds knowledge base and is beneficial for learning.

o   Top global researchers must work in coordination with authors from foreign universities and countries. This will result in the cross-cultural research productivity and deep understanding of the phenomenon.

o   Inter-organization collaboration must also be enhanced.

o	African researchers must collaborate with their counterparts in other countries to improve their research productivity.

o	A similar study can be conducted to analyze the documents indexed in the ISI web of science database.

Delimitation of the Study

The study is delimited to the analysis of the articles indexed in the Scopus database and related to the concept of accidental exposure to the information. The investigation covers the information sources indexed in the Scopus database.

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