

# Use of Open Access Publishing by Researchers: An Analysis of Open Access Availability of Research Literature in the field of Digital Library

Mohammad Nazim\* and Sana Zia

*Department of Library & Information Science, Aligarh Muslim University, Aligarh - 202 001, India*

*\*E-mail: nazim76@gmail.com*

## ABSTRACT

This paper aims to examine the availability of Open Access (OA) research literature in the field of digital library. In order to analyse the availability of OA research literature in the field of digital library, a search was conducted on Web of Science's Core collection database on June 11, 2019. In response to a topic search TS = "Digital Library" using the advanced search option, 849 articles were retrieved. Of the 849 articles examined, the details of 26 articles were not found in the Google Scholar. Therefore, 823 articles were selected for further analyses. After examining the Websites of OA articles, they were classified into three categories: gold OA, green OA, and both gold and green OA. Furthermore, all the green OA articles were systematically organised into six groups for the examination of the self-archiving venues used by the researchers for self-archiving. Out of 823 articles analysed, OA versions were found for 64.76 per cent of articles. This study found that 26.68 per cent of OA articles were available through gold OA and 60.39 per cent articles were available through green OA, while 36.53 per cent articles were accessible via both OA journals and self-archiving (gold & green OA). Although researchers used various OA platforms for self-archiving of their research work, publishers' Websites were found as the most preferred choice for self-archiving of research work by the authors in the field of digital library. Computer Science discipline has the highest share of OA copies available through self-archiving. However, it is important to point out that more than 78 per cent of self-archived articles were found as the final publisher's PDF versions of the article which publishers never allow for self-archiving.

**Keywords:** Open access scholarly communication; Digital library; Self-archiving; Gold OA; Green OA.

## 1. INTRODUCTION

Open Access (OA) to scholarly communication has become an important and interesting topic of research. The concept of OA was emerged as a revolutionary movement during 1990s for promoting free access to scholarly publications over the Internet, removing the price and permission barriers and ensuring the widest possible dissemination of research<sup>1-2</sup>. Today, OA has become an international academic movement that strives for free and open online access to academic information, such as scholarly publications and research data. OA movement has now embraced by the researchers, research institutions, funding organisations, governments and publishers worldwide.

OA can be defined as a process of providing immediate and permanent online access to the full text of research literature free of charge for anyone, worldwide without any restriction. There are two widely accepted methods for providing research literature openly accessible to the public: gold and green. Gold OA refers to the primary publication of the articles in OA journals, monographs, or as contributions to openly accessible edited volumes or conference proceedings. On the other hand, green OA deals with the OA availability of

article published in subscription-based journal by putting it in a repository or institutional website before or after publication, depend on the copyright policy of a journal. This practice is also known as self-archiving<sup>2-3-4</sup>. Self-archiving is one of the important methods used by researchers for increasing the impact of their research work by making it freely and widely accessible. Gradually, researchers around the world are taking interest in self-archiving. Researchers usually self-archive their research work in order to maximise its visibility, accessibility, usage and citation impact. Authors have many options for self-archiving of their research work. They upload their research work at different self-archiving venues, including Institutional Repository or Subject based- digital repository, ResearchGate, Personal Websites or Organisational Websites<sup>5-6</sup>.

There is an increasing interest among researchers towards the use of OA scholarly publishing. As of June 2019, Directory of Open Access Journals (DOAJ) indexed 13,425 OA journals published from more than 150 countries across the globe. Similarly, 4,153 digital repositories listed in the Directory of Open Access Repositories (OpenDOAR). A number of institutions across the world have created institutional repositories for providing research outcome of their researchers openly accessible. Researchers are willingly contributing their research work for publication in OA journals and putting

preprints of articles at different self-archiving venues for making them openly accessible<sup>7-10</sup>.

In the past few years, a number of studies have examined the availability of OA research literature across disciplines and countries<sup>11-17</sup>. Although, there are many studies conducted on OA availability of literature and self-archiving pattern in different subjects, but surprisingly no study was found which has examined the OA availability of research literature and authors' self-archiving behavior in the field of digital library. Therefore, this study has been conducted to examine the availability of OA literature in the field of digital library and an attempt is made to fill this research gap.

## 2. LITERATURE REVIEW

OA resources are in digital form, free of charge, without copyright and licensing restrictions. User can read, download, copy, distribute, print, search, or link to full texts of these articles, without any cost for access; however, they may be varied from texts and data to software, audio, video, and multi-media<sup>18-19</sup>. In 2001, Budapest OA Initiative (BOAI) gave new phenomenon in the scientific publishing and scholarly communication and as a result new technology have emerged to make conceivable public good. During the time of serial crisis, OA emerged as a solution to change circumstances<sup>20</sup>. There are two routes of OA namely: Green and gold which had been used by researchers for making their research work openly accessible since the late 1990s. The gold route refers to the publication of the research articles in OA journals which are freely accessible on the web, whereas green OA refers to as indirect free access to an article either an earlier version (preprint) or publisher's version (post print) of the manuscript that is available on the Web at a location other than the Website of the journal's publisher. Researchers mostly upload pre or post print in OA digital repositories, or their institutional repositories, and this practice is known as self-archiving<sup>2-3-11-13-21-25</sup>.

In today's world the most complex and advanced form of information systems is Digital library which has become an important assets to the users. It provides digital content to the users. OA institutional repositories are also associated with the concept of a digital library. Digitisation of the library has become part of the work of librarians, and most of the libraries are involved in digitisation. The preservation of material and its easy access by researchers and users are the main aim of digital libraries. Many researchers and specialists have conducted research on digital libraries<sup>8-9-26-27</sup>.

Hassall<sup>28</sup> examined self-archiving policies of journals in the field of Ecology and Evolution. This study found that maximum number of the articles published in the year 2011 were archived as publishers' version, which against the policies of most of the journals publishers. Similarly, Antelman<sup>29</sup> examined the author's behaviour towards self-archiving practice. Significantly, the study been found that authors mostly self-archive publisher PDF versions and also self-archive their work at multiple locations like institutional repositories, personal Websites and academic and social networking sites. Laakso<sup>3</sup> explored the availability of articles published in subscription-based journals in OA domain through self-archiving. This study found that 78.1 per cent publishers

allowed authors for self-archiving of accepted manuscripts. Authors mostly used personal Websites and institutional repositories for self-archiving. Spezi, *et al.*<sup>30</sup> explored that Medical and Life Sciences researchers often signed of ambiguity between their repository behaviours and the author or reader perspective, whereas researchers in Physical Sciences & Mathematics confirmed a strong alignment between their attitudes and behaviours as authors or readers.

Recently, Ahmadi & Nazim<sup>5</sup> analysed the self-archiving practices of Library and Information Science (LIS) professionals in India. They found that self-archiving practices among LIS professionals in India were very much common. Findings of this study revealed that India secured first position among Asian countries and fourth position in the list of top contributing countries of the world.

Additionally, a few studies have analysed the availability of OA scholarly publications in different disciplines through green and gold routes of OA. Van Leeuwen, *et al.*<sup>15</sup> found that OA journals output was lagged behind when compared with non-OA journals in Denmark, Netherlands and Switzerland. On the other hand, Funamori<sup>11</sup> found that worldwide 10.9 per cent of all articles were published in OA journals in 2013. However, Japan secured fourth rank in terms of a total number of publications with 12 per cent which were larger than the world average (10.9 %). In a study Torres-Salinas, *et al.*<sup>13</sup> found that Spain hold second rank in the European countries in terms of gold OA publication with 9 per cent of the Gold OA publications of the world. Matsubayashi, *et al.*<sup>12</sup> in their study in their study found that the 27 per cent articles in biomedical sciences published in 2005 were freely available and also found that journal publisher's Websites were the most prominent venues for self-archiving, while very few OA articles were found in Institutional Repositories or authors' personal Websites. While, Nazim & Zia<sup>2</sup> in their study found that ResearchGate and Institutional Repositories were the most preferred venues for self-archiving by the researchers in IITs. In contrast, a study by Way<sup>16</sup> found that authors were more likely to place their work on personal Websites. However, another study by Nazim & Zia<sup>31</sup> which examined the trend of OA availability of research publications in AMU, has found that faculty and researchers were contributing their research work in OA journals and self-archived their articles in ResearchGate and on the Websites of their institution. Similarly, Jamali & Nabavi<sup>32</sup> examined the OA availability of journal articles across all major research disciplines via Google Scholar and found that ResearchGate is mostly used by the authors for self-archiving of their research work. Significantly, Wren<sup>17</sup> examined the accessibility of OA articles from those 13 journals listed in the Medline. This study found a correlation between the impact factor of the journals and the OA availability of articles on the websites of the journals. Studies by Archambault, *et al.*<sup>33</sup> and Piwowar, *et al.*<sup>34</sup> examined the OA availability of scholarly literature in sciences. The studies found that almost half of all recently published articles in scholarly journals were freely available on the Internet.

Some studies were also conducted to identify the availability of OA scholarly literature through green and gold routes of OA across the subjects and countries<sup>11-15-25-35-36</sup>. But,

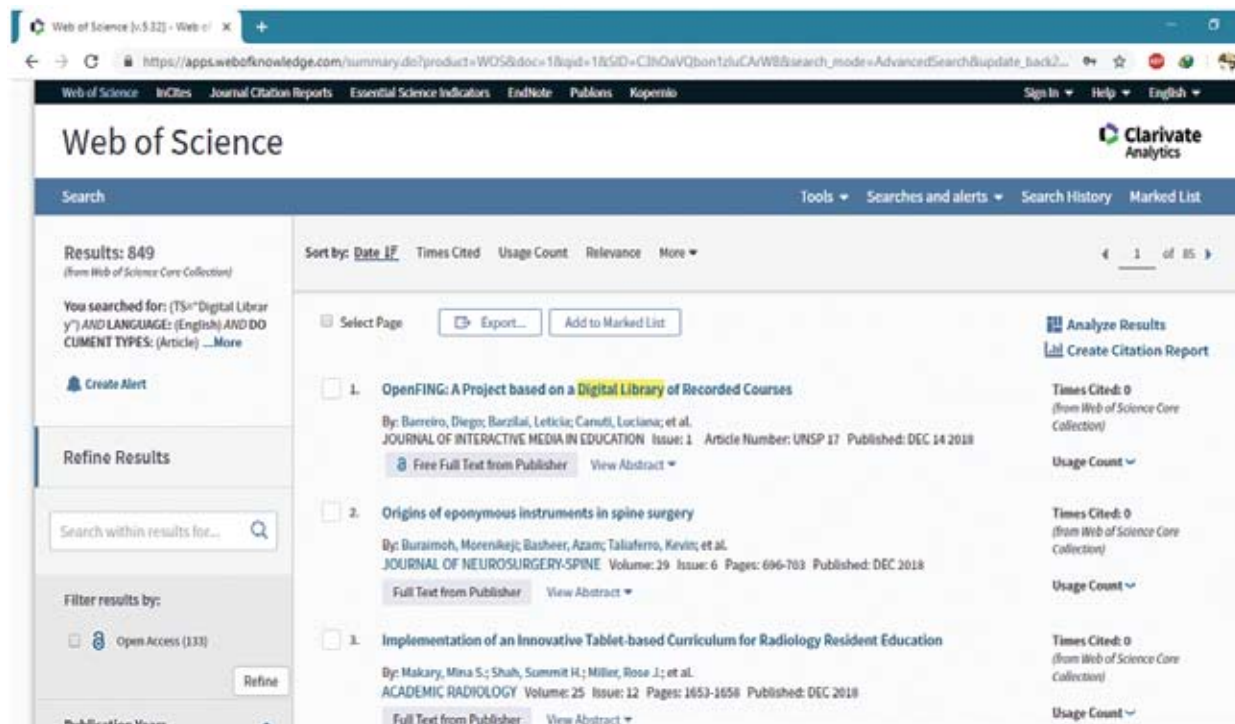


Figure 1: Search Strategy (Source: Web of Science).

no study has however conducted to examine the current status OA availability of digital library research and author self-archiving behaviour in the same field. Therefore, this study aims to examine OA availability of research literature and authors' self-archiving practices in field of digital library.

### 3. OBJECTIVES

The main objective of the study is to examine the OA availability of scholarly literature in the field of digital library. However, the specific objectives of the study are as follows:

- To examine the availability of OA scholarly literature in the field of digital library
- To examine the use of different routes of OA (Gold and Green) by researchers in the field of digital library
- To identify different venues used by researchers for self-archiving of their research work
- To examine the availability of OA versions of self-archived articles in different sub-disciplines
- To investigate year-wise distribution of publications and share of annual publications with at least OA availability of one copy.

### 4. METHODOLOGY

This article investigates the availability of OA research literature and authors' self-archiving pattern in the field of digital library. The bibliographic data was retrieved from Web of Science's Core Collection database on June 11, 2019. A search statement, as shown in the Fig. 1, formulated using advance search option: TS='Digital Library' The retrieved results were delimited by selecting the options 'journal articles' published in the 'English language' during 2009 to 2018. Using this search strategy, 849 articles were retrieved.

Thereafter, selected articles were imported to MS Excel

sheet for further analyses. The OA availability of articles was examined by searching the title of each article in the Google Scholar. When the article was found in the Google Scholar, the following details of each article were identified and then noted:

- is it the same article that was searched (same author names and bibliographic detail)?
- is it a full text (full length article with tables, figures and references)?
- is it any citation for the article; and
- is it an OA version of the article?

If an OA version of the article was found, the URLs of all its OA versions were recorded. This was done off-campus, without access to paid journal content. Out of 849 articles, the detail of 26 articles could not be found in the Google Scholar and, therefore, they were excluded for further analyses.

After analyzing URLs of all OA articles, they were classified into the following categories:

- Gold OA –Articles published in Pure and Hybrid OA journals
- Green OA –Article available through self-archiving
- Both gold and green OA – Articles available through both the gold and green routes of OA.

Each green OA article was again classified into following categories for determining the self-archiving venues used by the authors.

- Institutional repository (IR)
- Subject Repository (SR)
- Researcher's Personal Website (RPW)
- Organisational Website (OW)
- ResearchGate (RG) and
- Publisher's Website (PW).

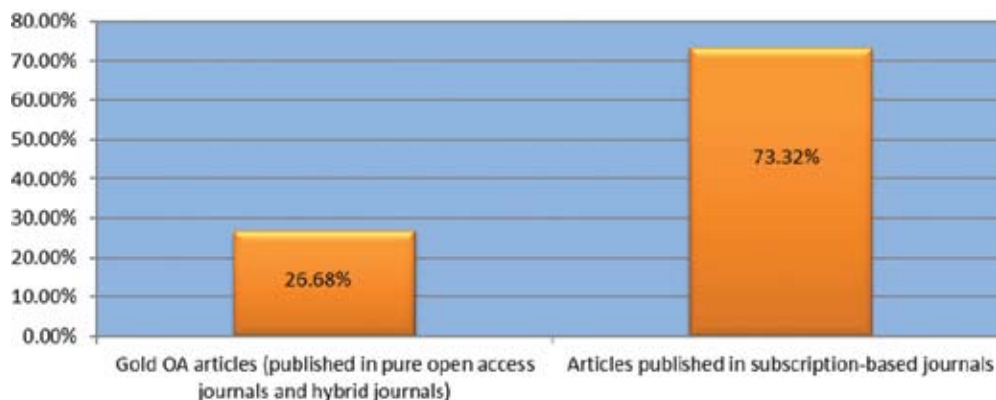


Figure 2. Mode of publication of articles.

Table 1. OA availability of research literature on digital library

Mode of publication of articles	Articles	Percentage
Gold OA articles (published in pure OA journals and hybrid journals)	219	26.68
Articles published in subscription-based journals	604	73.32
Total	823	100
Mode of OA availability of articles		
	Frequency	Percentage
Gold OA articles (not archived)	17	3.08
Green OA articles (Published in subscription-based journals but self-archived by authors)	334	60.39
Both gold and green OA articles (Published in OA journals and archived)	202	36.53
Total	553	100

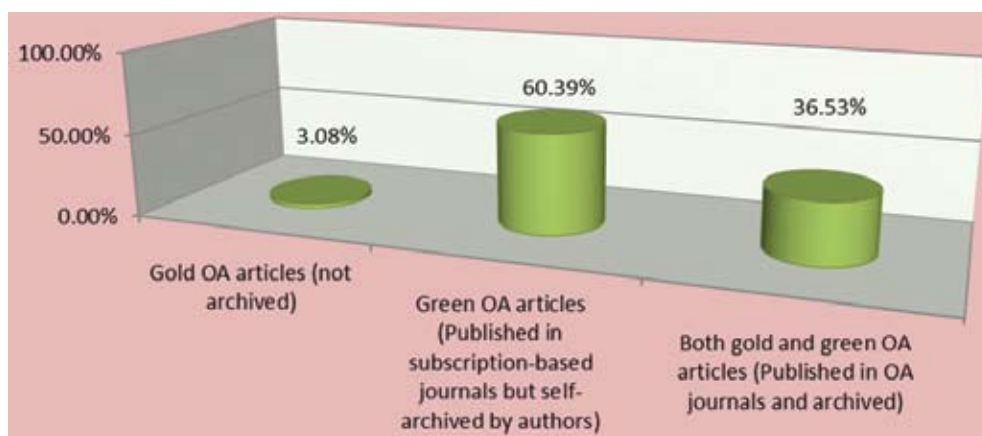


Figure 3. Mode of open access availability of articles.

Articles which were self-archived (available through green route of OA) were again classified into three categories: (a) Pre-Print Version (PP); (b) Accepted Version (AV); (c) Publisher’ PDF Version (PV). The detail of the availability of research literature via different modes of OA is shown in Table 1.

## 5. RESULTS

### 5.1 OA Availability of Research Literature

Of the 849 articles examined, the details of 26 (3.07 %) articles were not found in the Google Scholar. Figure 2 shows that out of 823 articles analysed, 219 (26.68 %) articles were published as OA in both pure OA journals and hybrid journals, whereas remaining 604 (73.32 %) articles were published in subscription-based journals. However, OA versions were found for 64.76 per cent of the articles. Of the total OA articles, 26.68 per cent articles were available via OA journals (gold OA) and 60.39 per cent articles were accessible through self-archiving (green OA), while 36.53 per cent articles were available via both gold and green routes of OA (Fig. 3).

### 5.2 Modes of Self-Archiving with Document Versions

In order to summarise the collected data as comprehensively as possible its breakdown was necessary. Table 2 provides a breakdown of every recorded observation per venues of self-archiving and subdivided by document version category found for all of the 536 articles. The data presented in Table 2 indicated that publisher’s version (78.39 %) of articles is the most frequent document version while, accepted version (8.22 %) of articles were hold least position in terms of document version. As may be seen in Table 2, more than 78 per cent self-archived articles were found in the form of final PDF version, which are not generally permitted by the publishers. From the analysis, it may be observed that researchers mostly prefer Publisher’s Website (36.97 %) for self-archiving of their articles whereas, researchers made

little use of subject repositories (0.34 %) for self-archiving of their articles.

### 5.3 Year-wise Distribution of Articles and Share of Annual Publications with at least One Copy Available Online for Free

Table 3 shows the year-wise distribution of articles with

**Table 2. Modes of self-archiving with document versions**

Venues	Document Version	Total
Institutional Repository (IR)	Pre-Print	25
	Accepted	24
	Publisher's PDF Version	41
Subject Repository (SR)	Pre-Print	0
	Accepted	1
	Publisher's PDF Version	1
Researcher's Personal Website (RPW)	Pre-Print	13
	Accepted	6
	Publisher's PDF Version	50
Organizational Website (OW)	Pre-Print	18
	Accepted	7
	Publisher's PDF Version	83
Research Gate (RG)	Pre-Print	13
	Accepted	6
	Publisher's PDF Version	50
Publisher's Website (PW)	Pre-Print	3
	Accepted	0
	Publisher's PDF Version	195

at least one copy available online for free. The year-wise distribution of articles ranges from 59 to 94 and the share of annual publications freely accessible ranges from 43.9 to 77.7 per cent. This study investigates no consistent tendency for those articles which are being available more frequently whether recent and older. A copy of freely available 536 articles producing a total share of OA through green route of OA to be 65.1 per cent. The study results indicate that year 2014 has the highest share (77.7 %) of annual publications with at least 1 copy freely available online, while least share (43.9 %) of annual publications was observed in the year 2013 (Fig. 4).

#### 5.4 Distribution OA Articles by Subjects

Table 4 shows the distribution of self-archived articles in different subjects. 536 self-archive articles in the field of digital library were distributed in 39 subject categories. Results indicated that computer science discipline has highest share of

OA articles (37.50 %), followed by Information Science & Library Science (29.64 %), Education & Educational Research (5.22 %) and Science & Technology (2.77 %). Anatomy & Morphology, Archaeology, Chemistry, Cultural Studies, Urban Studies have lowest share of self-archived articles.

## 6. CONCLUSIONS

This study analysed the availability of OA scholarly literature in the field of digital library. Of the total articles examined, OA versions for the 64.76 per cent articles were found. In total, 26.68 per cent articles were available through gold OA route, while 60.39 per cent articles were available through green OA route (Self-archiving). In a similar study, Bjork<sup>37</sup> examined that 25 per cent research articles were accessible through gold OA. However, findings of another study by Nazim & Zia<sup>2</sup> revealed that 58.44 per cent OA articles were accessible through green route. Similarly, a study by Hua, *et al.*<sup>38</sup> found that 58 per cent articles were available through gold OA in the field of oncology, where 34 per cent articles were accessible via OA journals (gold OA), and 46 per cent articles through self-archiving (green OA).

Finding of the present study indicated that researchers mostly prefer publishers' website for self-archiving of their articles. A similar study by Matsubayashi, *et al.*<sup>12</sup> found that 70 per cent articles in biomedical sciences were freely available on publishers' Websites. However, Nazim & Zia<sup>2-31</sup> in recent studies; reported that researchers in Indian Institutes of Technology and AMU were mostly use ResearchGate and IRs for self-archiving of their research work. Another study by Hua, *et al.*<sup>38</sup> also found that ResearchGate and the PMC were the main venues for providing articles openly accessible in the field of oncology.

It may be concluded that OA availability of research literature in the field of digital library has significantly positive impact on the scientific research publications. The study findings revealed that more than 26 per cent of the total articles in the field of digital library were available through gold route of OA, whereas, 64.76 per cent articles of the total were available through green route of OA viz. self-archiving at different venues. Computer science subject has highest share of OA articles available through self-archiving. Authors mostly prefer to use publishers' Website for self-archiving of their articles. The study finding also indicates that researchers are lacking an awareness of publishers' self-archiving policies, as 78 per cent self-archived articles were found as publishers' final PDF version. This study reflects the current trends of OA availability of research literature on digital library, the findings of the study may not be generalised to other subject areas. Further studies may be conducted to depict the general trend of

**Table 3. Year Wise distributions of publication and share of annual publications with at least 1 copy available online for free**

Publication	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Published articles (unique)	93	75	59	75	91	72	79	93	92	94	823
Articles with at least one free copy available online	58	55	38	54	40	56	47	64	56	68	536
Per cent	62.3	73.3	64.4	72.0	43.9	77.7	59.4	68.8	60.8	72.3	65.1

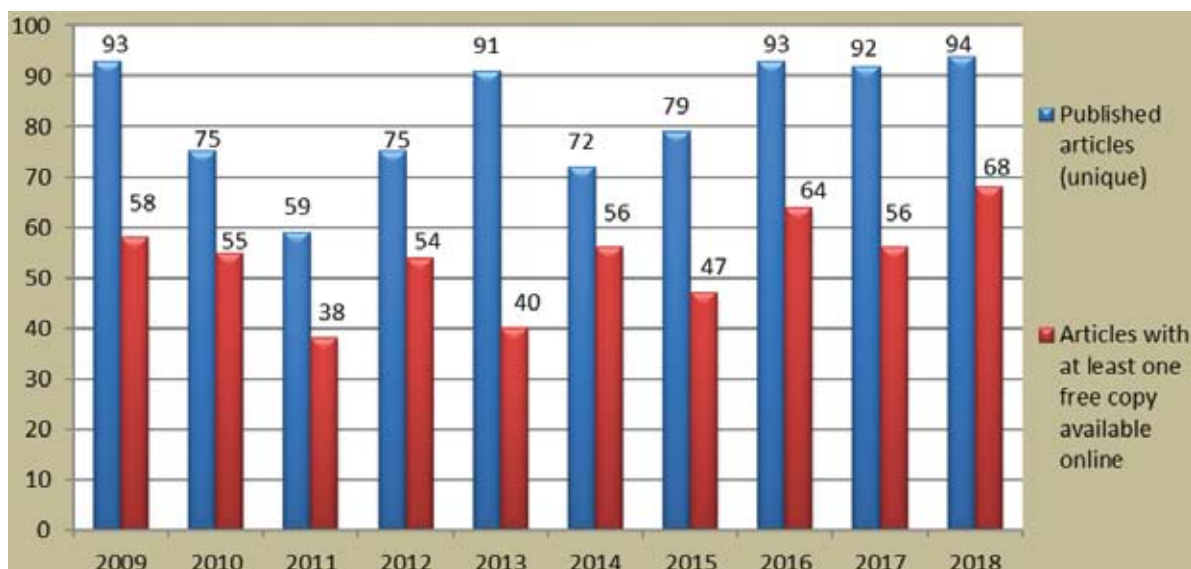


Figure 4. Year wise distributions of publication and share of annual publications with at least one copy available online for free.

Table 4. Self-archiving pattern in different sub-disciplines

Sub-Disciplines	Self-Archive Articles	Per cent	Sub-Disciplines	Self-Archive Articles	Per cent
Computer Science	201	37.50	Obstetrics & Gynecology	4	0.77
Information Science & Library Science	159	29.64	Orthopedics	3	0.55
Education & Educational Research	28	5.22	Public, Environmental & Occupational Health	3	0.55
Science & Technology	15	2.77	Radiology, Nuclear Medicine & Medical Imaging	3	0.55
Engineering	11	2.05	Religion	3	0.55
Psychology	11	2.05	Biophysics	2	0.34
Arts & Humanities	10	1.86	Business & Economics	2	0.34
Biochemistry & Molecular Biology	7	1.30	Communication	2	0.34
Medical Informatics	6	1.11	Environmental Sciences & Ecology	2	0.34
Area Studies	5	0.99	Genetics & Heredity	2	0.34
Automation & Control Systems	5	0.99	Government & Law	2	0.34
Dentistry	5	0.99	Materials Science	2	0.34
History	5	0.99	Oncology	2	0.34
Mathematics	5	0.99	Social Sciences	2	0.34
Anthropology	4	0.77	Anatomy & Morphology	1	0.18
Gastroenterology & Hepatology	4	0.77	Archaeology	1	0.18
Health Care Sciences & Services	4	0.77	Chemistry	1	0.18
Literature	4	0.77	Cultural Studies	1	0.18
Neurosciences & Neurology	4	0.77	Urban Studies	1	0.18
Nursing	4	0.77	Total	536	

OA availability of research literature by taking samples from different subjects.

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## CONTRIBUTORS

**Dr Mohammad Nazim** is an Assistant Professor at the Department of Library and Information Science, Aligarh Muslim University (AMU). He holds a Ph.D. in Library and Information Science from Banaras Hindu University (BHU) and a Master's degree in Library and Information Science from AMU. He is a member of the Editorial Board of the Journal of Information. His research interests include open access to scholarly communication, knowledge management, Bibliometrics/Scientometrics and information storage and retrieval.

**Ms Sana Zia** is a PhD student in the Department of Library and Information Science, Aligarh Muslim University, Aligarh. She obtained Master degrees Library & Information Science from Aligarh Muslim University, Aligarh. Her research interest includes open-access scholarly communication.