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Digital object identifier and its use in core Chinese academic journals: A Chinese perspective

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Abstract

Digital object identifiers (DOIs) are widely used across the world but not very much within China. This paper investigates the current usage of DOIs in China. Using an isometric method, we sampled 238 core Chinese academic journals from the Chinese Science and Technical Journal Citation Reports (2015 version, Core Edition), which includes 2,383 journals in total. According to our investigation, we found that: (1) although 80.25% of journals assign DOIs, 42.41% have only assigned DOIs to articles published after 2010; (2) most journals (89.01%) register DOIs through Institute of Scientific and Technical Information of China; and (3) only 84.82% of journals that register DOIs include them in the articles. This paper looks at the reasons for the limited implementation of DOIs and makes suggestions as to how usage can be expanded in China.

INTRODUCTION AND BACKGROUND

In 1998, the Association of American Publishers (AAP) was involved in the setting up of the International DOI Foundation (IDF) and thus the digital object identifier (DOI) was created. The DOI was jointly managed and operated by IDF, Corporation for National Research Initiatives (CNRI), and all the registration agencies (RAs) (Paskin, 1999, 2010; Tamizhchelva, Ganesh, & Swaminathan, 2003).

After 20 years in development, the DOI was approved as an ISO standard and has been widely accepted and used in full-text searching, citation linking, and digital copyright. Over 70% of western journals have registered DOIs (Ren, Liu, & Pu, 2010). Currently, over 90% of western publishers, including large-scale publishers such as Springer Nature, Elsevier, and Wiley have joined the Crossref system, which is the RA specializing in scholarly content. According to the data from the Crossref annual report 2014–2015, about 7,500 publishers and more than 40,000 periodicals are members of Crossref, and over 73 million DOIs were issued in the first half of 2015 (Crossref, 2014), which is a huge increase compared to membership in 2007 (Zhao & Ling, 2007).

As we all know, Chinese researchers are the second-largest group of published authors in international journals (Sun, 2016), but perhaps, it is not known to all readers that China, at the same time, has about 10,000 journals (Duan, 2016) and about 6,430 academic journals (SAPPRFT, 2014, 2017), and most of them publish in Chinese. China is one of the major producers of published content (journals and articles), although its publications lack international recognition. DOI offers a way to assist Chinese journals spread their influence to the world. Therefore, it is necessary to analyse the current DOI usage in China. The aim of this paper is to shed light on the following aspects: (1) the current DOI usage in Chinese journals through sampling of 238 journals' data, (2) analysis of why DOI usage is low in China, and (3) suggestions for expanding DOI usage in China.

METHODOLOGY

Using both quantitative and qualitative analyses, the Institute of Scientific and Technical Information of China (ISTIC) has selected

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Key points

- Only 80% of sampled Chinese journals are registered for digital object identifiers (DOIs).
- Only 1% of sampled Chinese journals add DOIs to their references.
- Of the sampled Chinese journals, 15% journals are registered for DOIs but do not allocate them.
- 11% of sampled Chinese journals have DOI parsing errors.
- Almost 90% of Chinese journal DOIs are registered by the Institute of Scientific and Technical Information of China.
- About 14% of Chinese journals do not have their own website but use Wanfang or CNKI as their digital publishing platform.

2,383 journals as core journals from about 10,000 journals in China (Duan, 2016) and thus created the Chinese Core Journals Database, which is updated annually. We briefly describe the selection process below.

In Chinese Science and Technical Journal Citation Reports (CSTJCR, 2015 version, Core Edition), 23 indexes or attributes are used; these include items such as total citation, impact factor, immediacy index, percentage quoted by others, number of citing journals, spreading factor, ratio of funded paper, number of organizations etc. The formula expressed below is used to calculate the score of each journal:

$$\text{Score} = \sum_{i=1}^{23} u_i k_i$$

where u is weight of each index, $k = (x - x_{\min})/(x_{\max} - x_{\min})$, x is the value of each journal of each index, $x_{\max}$ is the maximum value of each index of each subject that this journal belongs to, and $x_{\min}$ is the minimum value.

Using this score, all journals are ranked, and 2,383 journals were chosen as the core journals. The database comprehensively assesses such journals and ranks them from high to low. Generally, such a database is a representative set of Chinese journals because of its comprehensiveness, authority, and objectivity, which involves 153 subjects including all disciplines, that is STM, humanity and social science (HSS) journals. The information has been used by indexes such as those published by Engineering Village and others to evaluate Chinese journals for a long time. Because so many kinds of journals are included, the isometric method seems to be a fair and feasible sampling method to choose journals.

Using the CSTJCR 2015 version, Core Edition content, we sampled 238 journals from the total list in August 12, 2016, selecting every 10th journal (i.e. 1, 11, 21, 31, etc.). Of our selection, 230 journals (96.64%) were in Chinese, and 8 (3.36%) were in English. In total, 199 journals (83.61%) are science and technology (S&T) journals, and the rest (39, or 16.39%) are HSS journals. A Chinese questionnaire survey website Wenjuanxin (http://www.sojump.com/) was used to survey and analyse the current availability of these journals from aspects of registration rate, archival registration time, DOI RAs and its proportion, parsing method and parsing direction, DOI link sources, self-built website, DOI usage of electronic version of papers, references, and website information.

RESULTS

DOI registration rate

The overall level of DOI registration rate of the selected journals is shown in Table 1. From Table 1, we can see that only 80.25% journals have registered DOIs. A comparison shows that the registration rate of journals in English (100%) is higher than for journals in Chinese (79.57%), while the rate of S&T journals (83.42%) is higher than that of HSS journals.

The system of registering for DOIs in mainland China may be different from other countries. Generally, the editorial office of each journal finishes the whole production process, including obtaining DOI authorization and assigning a DOI to each paper. Then, the full-text database owners, Wanfang or Chinese National Knowledge Infrastructure (CNKI), or some collaborative publishers (e.g. western publishers), as authorized organizations upload paper information to the DOI RA. Journals can obtain the DOI service from different RAs, such as DOI of ISTIC (which is part of Wanfang) and DOI of CNKI, which will be discussed later. The DOI service and full-text indexing and uploading service are often undertaken by different companies to the journal parent organization (e.g. Wanfang on behalf of the journal parent organization). Most commonly, this uploading process is performed by the publishing databases, which – at the same time – publish the journal content in their own system and sell it.

TABLE 1 Overall level of digital object identifier registration of 238 journals sampled.

		Registered journal				Unregistered journal
Item	Total	In Chinese	In English	S&T journal	HSS journal	
Number of journals	191	183	8	166	25	47
Percentage (%)	80.25	79.57	100.00	83.42	64.10	19.75

HSS, humanities and social sciences; S&T, science and technology.

TABLE 2 Archival registration time of sampled journals.

Item	Since 2010	2000–2009	1990–1999	1980–1989	Before 1979	Start publication year
Number of journals	81	54	22	20	14	18
Percentage (%)	42.41	28.27	11.52	10.47	7.33	9.42

TABLE 3 Digital object identifier registration agency services in mainland China.

Agency	Number of journals	Percentage (%)
DOI of ISTIC	170	89.01
DOI of CNKI	12	6.28
Crossref	9	4.71

CNKI, Chinese National Knowledge Infrastructure; ISTIC, Institute of Scientific and Technical Information of China.

There are three kinds of errors that frequently occur with this system: the wrong DOI is registered, errors in uploading relevant information, and problems with the associated URL linked to the DOI (either because the registered URL is invalid, or it has changed and the metadata is not corrected with the RA). During our survey process, we found that some of the journals do have such parsing errors. For example, there is a certain journal that registered using the DOI of ISTIC and featured different DOIs on each paper, but these DOIs do not work. The reason is that the metadata was not uploaded to any RA or to the IDF. Therefore, we classified the journals whose DOI cannot be parsed correctly as unregistered journals in Table 1.

When undertaking our investigation, because we selected 238 journals with thousands of articles, we could not verify every article's DOI, so we had to randomly choose 20–30 articles from each journal for each year. If all the articles within one journal did not parse correctly, we treated it as an error journal. After finishing this process, we contacted the RAs, discussed the identified problems with their staff, and confirmed if there were problems. In summary, we think there are about 11.76% of sampled journals (28) that have parse errors with their DOIs.

Archival registration of DOIs

The archival registration time of sampled journals is shown in Table 2. From Table 2, we can see that 42.41% of the journals only registered DOIs for articles published since 2010, which means that almost half of the journals have, at most, 6 years of DOIs. Only 28.27% journals can trace their published papers by registered DOI back to 2000–2009. Only 18 journals (9.42%) have assigned DOIs to all archival articles.

Registration agencies

At present, there are 10 DOI RAs worldwide, that is Crossref, Entertainment Identifier Registry (EIDR), DataCite, mEDRA, OP (Publications Office of the European Union), KISTI, Japan Link Center, DOI of ISTIC, DOI of CNKI, and Airiti. RAs collect information such as DOI code form, URL, and necessary metadata obtained from publishers. Only publishers or other authorized institutions can generate and allocate DOI to content, for example papers, documents, figures, tables, and the rest.

Three RAs operate in mainland China: China DOI of ISTIC (abbreviated as DOI of ISTIC, which is a subsidiary company of Wanfang, which, in turn, is a subsidiary company of ISTIC), International DOI Centre of China National Knowledge Internet (abbreviated as DOI of CNKI), and Crossref. DOI of ISTIC allocates DOIs for Chinese-language journals. Crossref registers DOIs for English-language journals. DOI of CNKI only offers DOI services to each collaborative journal on its database (for free). Crossref is the biggest RA in the world, providing a global service. The status of the DOI RA service in China is shown in Table 3. From Table 3, we can see that 89% journals choose DOI of ISTIC (the first RA in the country) as their RA – far more than the other two RAs. As it is difficult to obtain data from Airiti, Taiwan, we just focus on the data collected from mainland China, i.e. only data from ISTIC and CNKI have been analysed in this paper. It should be pointed out that only one Chinese journal obtains DOI services from CrossRef, *Acta Psychologica Sinica*.

DOI parsing

The DOI system is composed of coding rules, metadata framework, parsing system, and management modes (Ren *et al*., 2010). There are two parsing methods, that is single-direction parsing and multi-direction parsing. Single-direction parsing means that there is only one URL address provided, and multi-direction parsing means that more than one URL address or other kinds of

TABLE 4 Hosting platforms that the digital object identifiers used by single-direction parsing journals resolve to.

Item	CNKI	Wanfang data	Self-built website	Collaborative publisher's database
Number of journals	93	66	21	9
Percentage (%)	49.21	34.92	11.11	4.76

Note: CNKI, Chinese National Knowledge Infrastructure; Wanfang data, Database of Institute of Scientific and Technical Information of China; Collaborative publisher's database, including foreigner publishers and Chinese publisher, that is NPG (1), IOP publishing (3), Elsevier (2), Springer link (1), BioMed Central (1), and Chinese Science Publishing & Media Ltd. (1).

TABLE 5 Journals with self-built websites.

Type	Total (%)	S&T journals (%)	HSS journals (%)	In Chinese (%)	In English (%)
Total	206 (86.55)	176 (88.44)	30 (76.92)	198 (86.09)	8 (100.00)
With DOIs	168 (70.59)	150 (75.38)	18 (47.37)	160 (69.57)	8 (100.00)
With OA	92 (44.66)	86 (43.22)	6 (15.38)	89 (38.70)	3 (37.50)
With OA and DOIs	83 (34.87)	78 (39.20)	5 (12.82)	80 (34.78)	3 (37.50)

DOI, digital object identifier; HSS, humanities and social sciences; S&T, science and technology.

metadata are provided. Almost all the sampled journals (189, or 98.95%) use the single-direction parsing method, with only two journals using the multi-parsing direction. By taking advantage of multi-direction parsing, a transition webpage is reached by the user, which offers different access choices, for example the journal's self-built website or one of the major databases.

Approximately 50% of journals sampled have signed an exclusive tie-up with CNKI, so they are not included on other websites. Some journals are hosted on both CNKI and Wanfang databases, but the DOI for all journals (except two) only directs to one source. This causes problems for readers who may find the DOI directing them to a database that they do not have access to (although they may have access to the article/journal on another database).

We found that 106 of the journals we sampled have signed exclusive deals to be hosted on CNKI, but only 90 of them obtain their DOI from CNKI – several of them do not have a DOI, and 3 obtain their DOI from other places, but these DOIs parse to the CNKI site (see Table 4 below, which shows where the single-parsing DOIs for the sampled journals direct the users to).

As can be seen in Table 4, more than 4 of 5 journals choose CNKI and Wanfang as their hosting platform, and all the sampled English journals parse their DOI to their collaborative publisher's database. Although the two main full-text databases (CNKI and Wanfang) wish to obtain exclusive online distribution rights (through exclusive contracts with the journals), less than 50% of journals choose to sign such an agreement, although the DOI of most of them will parse to the full-text database and not to the journal's own self-built website. Table 5 provides information about journals that have their own self-built website and that provide open access (or at least free access) to their journals on their own websites, although they may be behind a toll access barrier on CNKI or Wanfang.

DOI identification in articles

It is advised that the DOI should be prominently featured in all the documents, regardless of the electronic version or the printed version, but this survey found that only 84.82% journals include the DOI in the electronic version (i.e. 162 of the 191 journals that allocated DOIs).The rate of inclusion of DOIs is even lower on the journals' self-built websites, with 37 of the 168 journals that allocate DOIs and have their own sites including it on the articles within their own websites.

DOI in references

The addition of DOIs to references is an important part of the rationale for allocation of DOIs – to enable linking and access to articles. However, this research discovered that only two journals included DOIs in their references (one English-language journal, one Chinese-language journal). A Chinese national standard of references launched in 2015 clearly stipulates that the DOI of reference, if a journal has one, should be presented, but it appears that journals are disregarding this.

DISCUSSION

In China, the CNKI first employed a unique identifier for Chinese Academic Journals (in its CD version) in 1998. The Chongqing Weipu Full-text Database (CQVIP) and the Chinese

TABLE 6 Comparison of DOI usage.

Item	Other regions	China mainland
Registration agency	Crossref, EIDR, DataCite, mEDRA, OP, KISTI, Japan Link Center, Airiti	DOI of ISTIC, DOI of CNKI, Crossref
Subject areas	All the subjects	Higher in Natural science, lower in social science
Data sources	Independently registered from all subjects, and data are complete	Multi-data sources; some of journals are passively registered, and the information is incomplete
Parsing	Unified database and fully parsing	Existing parsing errors

CNKI, Chinese National Knowledge Infrastructure; DOI, digital object identifier; EIDR, Entertainment Identifier Registry; ISTIC, Institute of Scientific and Technical Information of China; KISTI, Korea Institute of Science and Technology Information; mEDRA, Multilingual European Registration Agency of DOI; OP, Publications Office of the European Union.

Academy of Medical Sciences (CAMS) tested a kind of SICI identification system and realized the direct link between an abstract database and full-text database in 2000, managed by different companies (Song & Xu, 2006). In 2007, the ISTIC became the first RA of IDF in China (for short, DOI of ISTIC). The Airiti Company in Taiwan and CNKI successively became RAs of Chinese DOI in 2012 and 2013 (DOI, 2013) after ISTIC. To date, China ranks second in DOI registrations; by November 2016, the total registrations of Chinese DOIs was about 25,242,607, and over 93.8% of these (23,689,630) are for journal articles (Duan, 2016).

Although China ranks second in the world in terms of the numbers of DOIs registered, it is still in the early stages of implementation and full use of the DOIs. Table 6 presents some of the main differences in DOI usage and implementation between China and other countries.

Admittedly, as Stanley and Yan (2007) said, 'It would be a mistake to underestimate China's own current scholarly journals publishing system', we still cannot lose sight of the fact that most Chinese journals are decentralized, and they are not collectivized in operation, management, and marketing. Journals with more stable financial support and relatively fixed staffing tend to be more conservative and traditional and less likely to take advantage of emerging technology, such as the DOI. The problems of DOI implementation and use in China may be resolved by focus on the following three areas: (1) more attention from all the stakeholders, not just editors; (2) a uniform standard for metadata extraction; and (3) the need for more Chinese productions, especially for Chinese journals and not just other already existing global products.

In our opinion, the reasons why China is still in the early stages of DOI implementation and usage may be due to the following:

Lack of deep understanding of the DOI: Under ideal circumstances, there is a positive correlativity between the national research level (which is sometimes represented by the number of published articles) and journal development. In recent decades, China has witnessed a massive growth in both the purchasing of (and access to) foreign-language journals by Chinese researchers and in the submission of articles written by Chinese scholars to western journals. Counting and analyzing the articles further, we find that STM papers account for much of this growth, and only a small part of it is in the HSS. That means that the majority of article submissions in HSS are still using Chinese and Chinese journals as their first choice, while it is different in natural science. At the same time, most of Chinese HSS journals are still regional publications, and there are few Chinese international journals in HSS. Researchers outside China do not recognize or even know our HSS journals. This could possibly explain the phenomenon that HSS journals have lower DOI usage rate, as shown above. A few Chinese English-language journals cooperate with western publishers, which may possibly lead to further adoption of new technology usage and thus help other Chinese journals make their own way in the world.

Lack of governmental support: As shown above, DOIs may parse to a journal's self-built website or to other databases. Parsing errors (e.g. incomplete parsing address and imprecise content) are possibly caused by incorrect URL information within journals' self-built websites; by the limited range of database usage, especially in the public domain; and by the failure to upload/register the DOI. Journal publishers often appear to be careless, inattentive, and disregarding of standards. They do not realize how important the DOI is, and it seems that they sometimes do not care about the completeness of metadata. This may be addressed by CNKI and Wanfang, with government support and more requirements from the funders, by pursuing increased usage of DOIs, for example the CNKI's overseas market expansion programme.

RECOMMENDATIONS FOR DOI USAGE IN CHINA

Based on the analysis and research, the authors propose the following suggestions for reform and change within the Chinese academic journals sector.

From the policy-making side:

- Encourage more journals to use DOIs, linking them to any kinds of literature, whether current issues or back issues, references, and other information.
- Encourage RAs, that is CNKI and ISTIC, to offer more services to each editorial office, such as technical support and low price or free linking cost.
- Encourage publishing administrators at all levels, from national to regional, to offer more policy and financial support to journals.

From the technology-using side:

- Encourage publishers to raise their level of understanding of DOIs and pay more attention to using the DOI and other related standards. Recommend adherence to the open Handle System Protocol, promote software development, and thus establish the unified standard of DOI parsing and the domestic parsing framework.
- Recommend multi-direction parsing by more journals to reduce the problems with single-direction parsing errors.
- Separate the editing and publishing of journals (editing by editorial staff and publishing by publishers) and thus find or form new publishing groups, either based on existing companies or by launching new companies. [This is already ongoing according to the updated information, e.g. China Academic Journal Electronic Magazine Co. Ltd (CNKI).] This will accelerate the development of Chinese publishing and help to catch up with western publishers.

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