Trends in Scholarly Publishing

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Global Status of Gold and Diamond Open Access Journals: Insights from DOAJ Data and Development Strategies

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ABSTRACT

Open access (OA) publishing has transformed global scholarly communication by promoting unrestricted access to research outputs. Among its models, Gold and Diamond OA journals play a vital role in enhancing knowledge dissemination and ensuring equitable access across disciplines. This study analyzes the characteristics of global Gold OA and Diamond OA journals indexed in the Directory of Open Access Journals (DOAJ) to provide a reference for the development of OA journals worldwide. This study retrieved and analyzed the subjects, languages, Creative Commons (CC) licenses, peer-review types, publishing status, and other characteristics of global Gold OA and Diamond OA journals indexed in DOAJ. Furthermore, OA publishing status from the top 5 countries (Indonesia, the UK, Brazil, the US, and China) indexed in DOAJ was analyzed and compared, based on which the development strategies of OA were summarized. Among the 22036 OA journals indexed in DOAJ, English-language journals (18188) account for the vast majority (82.5%). Among them, 63.1% (13902) are Diamond OA journals, which are mainly in the social sciences. CC BY is the primary type of CC licenses, followed by CC BY-NC-ND and CC BY-NC. The peer review modes are scattered. DOAJ only indexes 501 Chinese journals, which are different from the global journals, especially in Indonesia, the UK, Brazil, and the US, indexed in DOAJ. Diamond OA accounts for the highest proportion in Brazil, in contrast with the Gold OA in the UK and the US. The publishers' characteristics of Brazil are also significantly different from the UK and the US. Bronze OA is the main OA mode adopted by China's journals. OA is beneficial for the dissemination of academic achievements and also enhances the visibility of journals; in addition, OA is an important component of open science, and OA journals should adopt specific OA models based on their own characteristics to adapt to the development of open science. Moreover, open-access infrastructure, such as CC licenses, DOAJ, repositories, and others means facilitate the development of OA, which provides the insurance for both authors and readers.

KEYWORDS

DOAJ, open access, gold OA, diamond OA, bronze OA, CC license

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INTRODUCTION

Open access (OA), as a component of open science, promotes scientific exchange and improves the efficiency of scientific research[1]. In 2001, the Budapest Open Access Initiative (BOAI) explicitly proposed the concept of OA with the aim of promoting scientific development and enhancing the public utilization of scientific research[2]. In addition, OA has also changed the business model of journals, with the payment end shifting from readers to authors. The development of science and technology has brought opportunities and challenges to the development and quality improvement of scientific journals. UNESCO actively advocates OA and open science to make technological development more efficient[3,4].

The Directory of Open Access Journals (DOAJ)[5] was established by Lund University of Sweden in May 2003, which indexes fully peer-reviewed OA journals, in order to enhance the visibility, reputation, and impact on disciplinary development of high-quality, peer-reviewed, and open academic journals worldwide. DOAJ is not limited by disciplines, regions, or languages. In addition to medical and technological journals, DOAJ indexes various fields of natural and social sciences as well. DOAJ truly reflects the development status of global OA journals. The indexing criteria of DOAJ have become the unofficial gold standard for evaluating OA journals.

The types of OA include Gold OA, Diamond OA, Green OA, Bronze OA, and hybrid[5]. The main difference between Gold OA and Diamond OA is whether the journal charges Article Processing Charges (APC). At present, DOAJ only includes fully OA (Gold OA and Diamond OA) journals; journals of hybrid, delayed OA, Bronze OA, and subscription modes with OA options are out of the scope of DOAJ[6]. In addition, DOAJ has clear requirements for the Creative Commons (CC)[7] licenses and the peer review strategy adopted by journals.

This study analyzed the development status and characteristics of DOAJ-indexed journals around the globe. The analysis included subjects, languages, CC licenses, peer review types, publishers, etc., and the differences of the OA journals published in Indonesia, the UK, Brazil, the US, and China indexed in DOAJ were compared as well.

Retrospective study methods and data sources

Comparative analysis of DOAJ inclusion: This is a retrospective study, and the data were pulled on 15 Sep, 2025. This study analyzed the OA publishing status of the globe and the top 5 countries (Indonesia, the UK, Brazil, the US, and China) indexed in DOAJ. Analysis parameters included language, subject category, license type, peer review types, etc. We analyzed the differences between groups through statistical methods.

According to whether APC is charged, journals were divided into two categories: Gold OA Journal and Diamond OA Journal. Then, subgroup grouping is performed based on various parameters. Subgroup grouping criteria:

- Language
- Disciplinary classification
- CC license
- Top five publishers
- Types of peer review

Among the journals indexed in DOAJ, many have multiple CC license options, and there are also multiple bilingual journals. Therefore, the total number of journals of different CC license types is not statistically significant.

Retrieval: The DOAJ retrieval methods include classification retrieval and keyword retrieval. The DOAJ has different types of settings, and DOAJ retrieval does not require users to input the retrieval language. Researchers only need to select the desired classification based on the settings. This study used the classification settings of DOAJ to retrieve the data.

In terms of classification search, DOAJ provides search parameter options such as subject classifications, languages, CC license types, publishers, publishing locations, peer review types, date added, and whether APC is charged.

Retrieval strategy for this study is as follows:

- The global OA publishing situation is based on the total data collected by DOAJ. For example, the publication location options for journals in China are: China, including the Taiwan Province of China and Hong Kong Special Administrative Region (SAR), and Macao SAR
- Language chosen English AND/OR others
- Classify journals into Scientific, Technical, and Medical (STM) journals and humanities and social science journals based on disciplinary types
- Other parameters such as date added, OA types, publishers, etc. Besides,
  - **Medicine:** Select the Medicine option
  - **Science and technology:** Science OR Agriculture OR Technology OR Military Science OR Naval Science OR Technology
  - **Social science and other subjects:** General works OR History OR Geography, anthropology, recreation OR Social science OR Fine arts OR Music OR Language and literature OR Law OR Bibliography, library science. Information resources

Statistical analysis: SPSS 20.0 statistical software was used to compare and analyze the data under various classification items of Gold OA and Diamond OA. The comparison of count data is conducted using Pearson's Chi-square test or Fisher's exact probability method. Dunn-Bonferroni analysis was used to analyze the differences in OA characteristics between Brazil, Indonesia, the UK, the US, and China. $p<0.05$ indicates a statistically significant difference.

Data visualized by R and Kimi and Excel, during which the online AIGC software Kimi moonshot (https://www.kimi.com/) was used to generate the program code for creating heat maps, then the code was tested by R, and the heat map was created. Alluvial diagram was created by RAWGraphs 2.0 (https://app.rawgraphs.io/)[8].

RESULTS AND DISCUSSION

Global journal inclusion in DOAJ

Growth trend: By September 30, 2025, DOAJ indexed 22036 OA journals, of which 13902 do not charge APC (Diamond OA), accounting for 63.1%, and 8134 are Gold OA journals, accounting for 36.9%. From the establishment of DOAJ in 2002 to 2014, the total journals indexed by DOAJ were relatively low, and there was a sharp drop in 2014. Since 2010, the total Diamond OA journals have surpassed the Gold OA journals. Then, since 2015, DOAJ has shown an upward trend in the inclusion of global OA journals, with over 1000 new journals added each year. Although each year in the recent 10 years, the annual growth volume was still larger than 1000 journals, the growth rate has been gradually down, especially since 2021. Meanwhile, DOAJ curated a global whitelist of immediate, CC-licensed OA journals, offered free APC-filtered search, awarded a Seal for best practice, tied inclusion to research-funding mandates, and shares reusable metadata to speed open-science adoption worldwide, etc. All these policies promoted the indexed volume of DOAJ. More details of the annual distribution and growth trend of OA journals included in DOAJ are shown in Fig. 1.

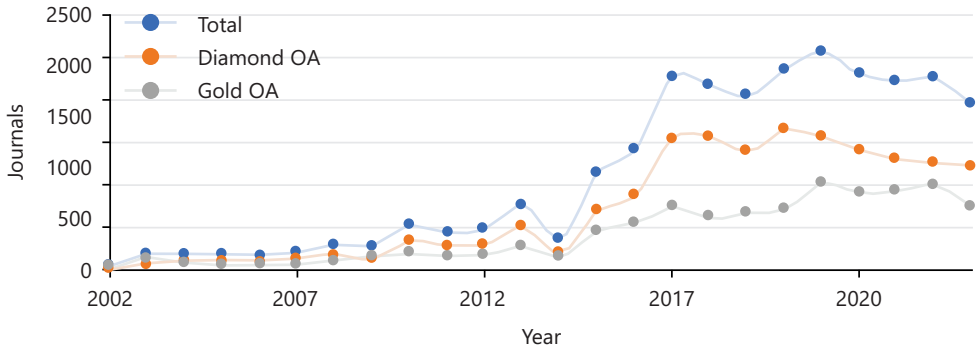


Fig. 1: Annual distribution of OA journals included in DOAJ

Table 1: Geographical distribution of global OA journals, including Gold OA and Diamond OA journals indexed in DOAJ

	Total		Diamond OA		Gold OA	
No.	Country	Journals (n)	Country	Journals (n)	Country	Journals (n)
1	Indonesia	2565	Brazil	1386	UK	1735
2	The UK	2218	Indonesia	1266	Indonesia	989
3	Brazil	1526	Spain	941	Switzerland	695
4	The US	1271	Poland	737	The US	649
5	Iran	1012	The US	622	Iran	424
6	Spain	995	Iran	588	Netherlands	371
7	Poland	957	Russia	567	China	369
8	Switzerland	790	Türkiye	559	Egypt	261
9	Russia	640	UK	483	Poland	220
10	Türkiye	594	Italy	471	Germany	157
11	Italy	538	Colombia	437	Brazil	140
12	China	501	Argentina	391	India	133
13	Netherlands	493	France	320	Iraq	128
14	Ukraine	447	Romania	298	South Africa	123
15	Colombia	441	Germany	274	Argentina	110
16	Germany	431	India	258	Korea, Republic of	89
17	Argentina	401	Ukraine	243	Russia	73
18	India	391	Mexico	215	Pakistan	70
19	France	360	Serbia	186	Italy	68
20	Romania	348	Chile	185	Australia	68

Global geographic distribution of DOAJ-indexed journals: Among the countries with OA journals indexed in DOAJ, Indonesia publishes the most (2565) OA journals, followed by the UK (2218) and Brazil (1526); the country that published the most Diamond OA journals is Brazil (1386), followed by Indonesia (1266) and Spain (941); The UK (1735), Indonesia (989), and Switzerland (695) have the highest number of Gold OA journals. OA journals mainly focus on Asia, Europe, and the Americas. However, this data also reflects that the number of OA journals included in DOAJ is still limited, and many hybrid journals have not been indexed in DOAJ (Table 1).

Among the 20 countries, 5 Asian countries (Indonesia, Iran, Türkiye, China, India) contribute 4053 OA journals (50.0 %); 11 European countries (UK, Spain, Poland, Switzerland, Russia, Italy, Netherlands, Ukraine, Germany, France, Romania) supply 8579 (42.1 %). In the Americas, 1 North American country (the US 1271) contributes 1271 journals (7.8 %), while 3 South American countries (Brazil 1526, Colombia 441, Argentina 401) add 2368 (14.6 %).

As far as the country-level differences to global OA policies, research results funded by the US federal government must be made openly accessible. While the UK has enacted nationwide mandates that every peer-reviewed article resulting from federal or UKRI funding must be OA immediately upon publication, via either the gold or green route, and without any embargo. Brazil actively promotes Diamond OA

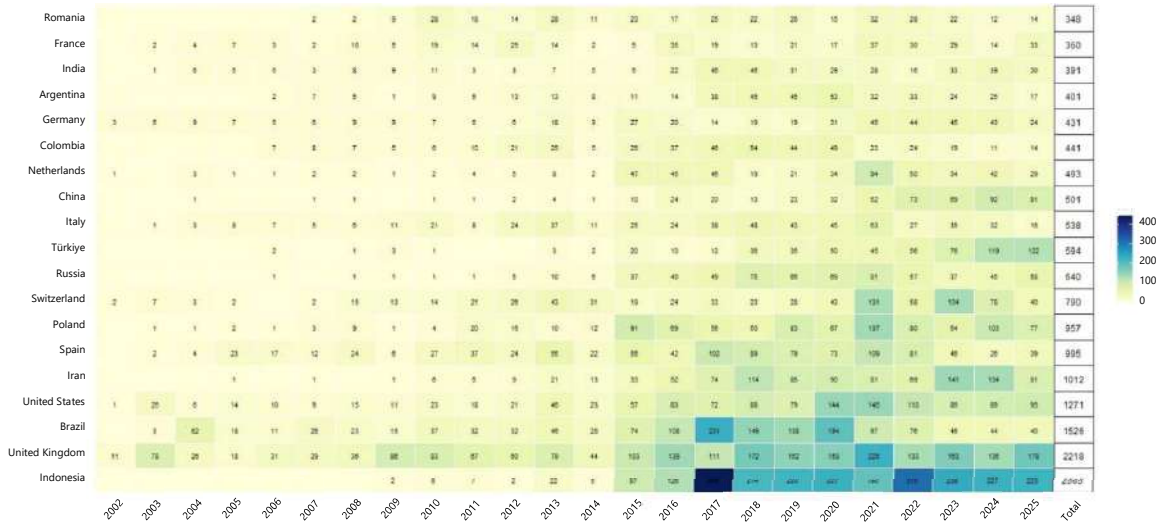


Fig. 2: Heatmap of the inclusion status of the top 20 countries included in DOAJ

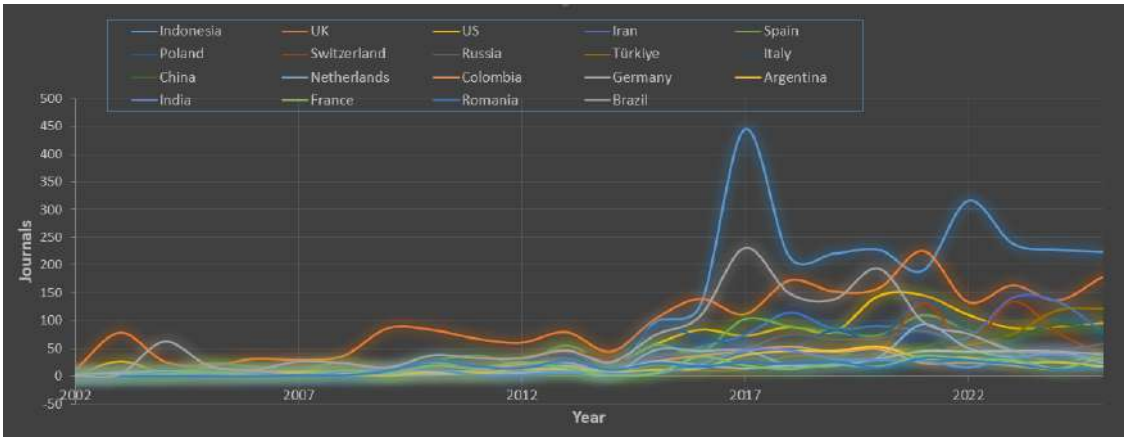


Fig. 3: Growth curve of the top 20 indexed countries from January, 2007 to September, 2025

through publicly supported platforms such as SciELO, and Indonesia, though without an explicit national mandate, shows exceptionally high Diamond OA output, likely driven by institutional initiatives. While in China, Bronze OA journals are still large, Bronze OA journals need to transform into Gold OA or Diamond OA.

The "Publishers Report on the Development of Open Access Publishing in China (2022)[9]", jointly compiled by the China Association for Science and Technology and the International Association of Science, Technology and Medical Publishers (STM), is an important measure for China to promote open science practice. Besides, Plan S was launched by cOAlition S on 4 September, 2018; over the past seventeen years, it has evolved from demanding immediate, CC-BY open access for all funded research to promoting Diamond OA, while UNESCO's 2021 Recommendation on Open Science entrenched the same zero-embargo, open-licenses principles worldwide and called on member states to embed them in national policy and infrastructure.

In addition, the geographical distribution of global OA journals, Gold OA, and Diamond OA journals indexed in DOAJ is imbalanced. The heatmap of the inclusion status of the top 20 countries included in DOAJ can be found in Fig. 2, and the growth curve in Fig. 3.

Table 2: Main feature analysis of global Gold OA and Diamond OA journals indexed in DOAJ

Group	Gold OA (n = 8134)	Percentage	Diamond OA (n = 13902)	Percentage	Total (n = 22036)	Pearson χ^2	p-value
Language						306.84	0.000
English	7271	40.0	10917	60.0	18188		
Non-English	863	22.4	2985	77.6	3848		
Subject						2243.37	0.000
Medicine	2679	55.9	2115	44.1	4794		
Technology	3545	49.8	3046	46.2	6591		
Social science	1910	53.8	8741	82.1	10651		
CC license						1089.45	0.000
CC BY	5589	49.4	5722	50.6	11311		
CC BY-NC	2074	42.6	2792	57.4	4866		
CC BY-NC-ND	2149	44.1	2723	55.9	4872		
CC BY-NC-SA	427	21.1	1599	78.9	2026		
CC BY-ND	139	34.7	262	65.3	401		
CC BY-SA	722	39.5	1106	60.5	1828		
Publisher's own license	33	17.0	161	83.0	194		
Public domain & CC0	92	92.0	18	18.0	100		
Peer review types						1911.47	0.000
Double anonymous peer review	2730	19.8	10151	73.8	13760		
Others[#]	4024	48.6	3751	45.3	8276		

#: Other peer review methods include fully open peer commentary and open peer review. In addition, a small amount of post-publication peer review and editorial board review is also included

Comparison of characteristics between Gold OA journals and Diamond OA journals recorded in DOAJ: This study analyzed the relationship between different characteristics of Gold OA vs Diamond OA in DOAJ.

Languages: There is a highly significant association between journal language and OA model ($p<0.0001$). English-language journals show a preference for Diamond OA (60.0%), while non-English journals strongly favor Diamond OA (77.6%).

Subjects: Comparison shows the strongest correlation with the OA model ($p<0.0001$). Social science journals overwhelmingly prefer Diamond OA (82.1%), while the result shows more balanced in medicine (44.1% Diamond OA), either does in technological journals (Gold OA 49.8% vs 46.2% Diamond OA). Social science includes sub-subjects, e.g., Auxiliary Sciences of History, Bibliography. Library Science. Information Resources, Education, Fine Arts, Geography. Anthropology. Recreation, History, Philosophy, Psychology, Religion, Political Science, Music, Language and Literature, Law.

CC license: The journals chose the CC BY account for the highest proportion ($p<0.0001$). More restrictive licenses (CC BY-NC, CC BY-NC-ND, CC BY-NC-SA) are more common in Diamond OA journals.

Peer review types: Double anonymous peer review is strongly correlated with the Diamond OA model ($p<0.0001$), with 73.8% of Diamond OA journals using this method compared to only 19.8% of Gold OA journals.

All factors mentioned above show statistically significant associations with the choice between Gold and Diamond OA models. This suggests that journal characteristics, including language, subject, licensing preferences, and peer review types, are important predictors of which OA model a journal adopts. The APC is an important factor of the author's choice, and CC BY, language, and subjects are equally important. The main feature analysis of global Gold OA and Diamond OA journals indexed in DOAJ is presented in Table 2.

Table 3: Top 5 publishers owned OA journals indexed by DOAJ in different countries

China	Total	Diamond	Indonesia	Total	Diamond	The UK	Total	Diamond	Brazil	Total	Diamond	The US	Total	Diamond
KeAi. Communications Co. Ltd	147	33	Universitas Negeri Semarang	93	35	Wiley	308	2	University of São Paulo	47	44	Elsevier	1891	1
Tsinghua University press	23	17	Universitas Airlangga	54	35	BMC	298	14	State University of Campinas	33	33	Wiley	98	1
Science Press	18	1	Universitas Gadjah Mada	35	14	Taylor and francis group	231	15	Federal University of santa catarina	30	29	SAGE publishing	60	1
Maximum academic press	17	0	Universitas Udayana	33	18	Elsevier	209	0	National council for Research and graduate Studies in law	29	29	eScholarship publishing	30	24
Open exploration Publishing Inc.	11	4	University of Brawijaya	33	12	SAGE publishing	133	29	Federal University of minas gerais	25	23	IEEE	29	1

S2O journals indexed by DOAJ: By the end of September 30, 2025, there were 73 S2O journals indexed in DOAJ, of which 29 were German journals, 23 were US journals, and 21 journals were from the UK.

Comparison of OA journals in 5 countries indexed by DOAJ

Publishers: In terms of publishers, in the US and the UK, the journals are mainly owned by international large commercial publishing groups, such as Wiley, Elsevier, SAGE Publishing, and vast majority of which are Gold OA journals. This is because gaining profit is the crucial purpose of the international publishing companies, while Diamond OA journals are always newly established in the US and the UK. As soon as the constantly sufficient manuscripts are submitted or included in international databases, such as SCIE, ESCI, or SSCI, especially with a high journal impact factor (JIF), the Diamond OA journals would transform into Gold OA journals. On the contrary, the top 5 publishers in Brazil and Indonesia are all operated by universities, instead of a publishing company. Moreover, Brazil has a higher proportion of Diamond OA journals. The top five publishers that operate OA journals in China are all publishing companies, in which KeAi Communications Co., Ltd., co-founded by Science Press and Elsevier, ranks first, followed by Tsinghua University Press and Science Press.

Due to the fact that international publishers such as Wiley and Elsevier have also established a large number of hybrid journals, the OA journals included in DOAJ also have a bias in terms of international publishers. The top 5 publishers owned OA journals indexed in DOAJ of China, Indonesia, Brazil, the UK, and the US are shown in Table 3.

Table 4: Characteristics analysis of OA journals in China, Indonesia, Brazil, the UK, and the US

	Countries						
Item	Indonesia	The UK	Brazil	The US	China	Pearson χ^2	p-value
Total	2565	2218	1526	1271	501		
Language						2037.3	<0.001
English	1934	2213	907	1268	315		
Others	631	5	619	3	186		
OA type						2423.7	
Gold	989	1735	140	649	369		
Diamond	1266	483	1386	622	132		
Subject						669.1	<0.001
Medicine	237	976	204	462	123		
Technology	613	857	284	401	356		
Social science	1715	385	1038	408	22		
CC license						2155.2*	<0.001
CC BY	747	2071	838	881	227		
CC BY-NC	279	867	322	324	31		
CC BY-NC-ND	38	743	192	550	259		
CC BY-NC-SA	321	81	142	50	0		
CC BY-SA	1167	37	17	23	0		
CC BY- ND	15	92	8	44	2		
CC0	0	81	0	14	0		
Publisher's own license	0	11	15	40	2		
Peer review types						2.02	0.998
Double anonymous peer review	1724	642	974	527	246		
Anonymous	549	1390	296	626	235		
Others#	293	186	256	118	20		

#: Other peer review methods include fully open peer commentary and open peer review. In addition, a small amount of post-publication peer review and editorial board review are also included. *: by Using Fisher's exact probability method

Table 5: Characteristics analysis of OA journals in China compared with Indonesia, Brazil, the UK, and the US by the Bonferroni test

Comparison item	χ^2 value	Raw p-value	Bonferroni p-value
Language overall	2037.30	<0.001	NA
China vs. Indonesia	45.9	<0.001	<0.001
China vs. the UK	1794.60	<0.001	<0.001
China vs. Brazil	343.5	<0.001	<0.001
China vs. the US	1808.90	<0.001	<0.001
OA type overall	2423.70	<0.001	NA
China vs. Indonesia	802.4	<0.001	<0.001
China vs. the UK	105.9	<0.001	<0.001
China vs. Brazil	1143.20	<0.001	<0.001
China vs. the US	312.2	<0.001	<0.001
Subject overall	669.1	<0.001	NA
China vs. Indonesia	217.6	<0.001	<0.001
China vs. the UK	279.9	<0.001	<0.001
China vs. Brazil	343.5	<0.001	<0.001
China vs. the US	312.2	<0.001	<0.001
CC license overall	2155.20	<0.001	NA
All pairwise	>100	<0.001	<0.001
Peer-review overall	2.02	0.998	NA
All pairwise	NA	>0.99	>0.99

NA: Not available

Characteristics analysis of OA journals in China, Indonesia, Brazil, the UK, and the US: The results of Table 4 and Table 5 show highly significant differences between the five countries in language distribution (Pearson χ^2 test), OA type (Pearson χ^2 tests), subjects, and CC license (Fisher's exact probability method) (all $p<0.001$). Pairwise comparisons revealed that China differed from each of the other four countries in these four dimensions, with Bonferroni-adjusted p values<0.001. In contrast, no significant heterogeneity was detected in peer-review methods ($\chi^2 = 2.02$, $p = 0.998$).

Regardless of which single country is compared against the pooled data of the other four countries, the differences in language, OA type, subjects, and CC license all reach extremely high significance ($p<0.001$).

The peer-review method remains non-significant across all comparisons.

Visualization analysis: The Alluvial diagram showed the correlations of the OA types with the CC license of the 5 countries in Fig. 4a-e. During which the UK and the US bear the characteristics of a larger proportion of Gold OA journals, and CC BY as well (Fig. 4b-d). It's obviously shown that the UK has the largest proportion of Gold OA journals. But in Indonesia, the total volume of Gold OA and Diamond OA journals is almost the same, CC BY-SA is preferred over CC BY (Fig. 4a). Interestingly, the most likely use of the CC license is CC BY-NC-ND in China (Fig. 4e). Besides, Brazil has the highest proportion of Diamond OA journals (Fig. 4c), and CC BY is the most chosen license.

Suggestions and inspirations for the development of scholarly OA journals

Characteristics and prospects of OA journals: OA journals' distributions around the globe are obviously imbalanced. In the top 20 countries, 5 are Asian countries, contributing 50.0% of the total number, 11 European countries account for 42.1%, and 4 American nations (Brazil, the US, Colombia, Argentina) account for 7.8 %. The Gold OA and Diamond OA are quite different from the total. Besides, the results of the comparison of the top 5 countries with the largest number of OA journals show significant differences.

The "Publishers Report on the Development of Open Access Publishing in China (2022)"[11] showed that there were a total of 1810 OA scientific and technological journals in China, accounting for 36.47% of the total number of scientific and technological journals in China. Among them, Bronze OA journals have the most, with 1459 types (29.40%); The number of Gold OA journals and Diamond OA journals is 227 (4.57%) and 23 (0.46%), respectively.

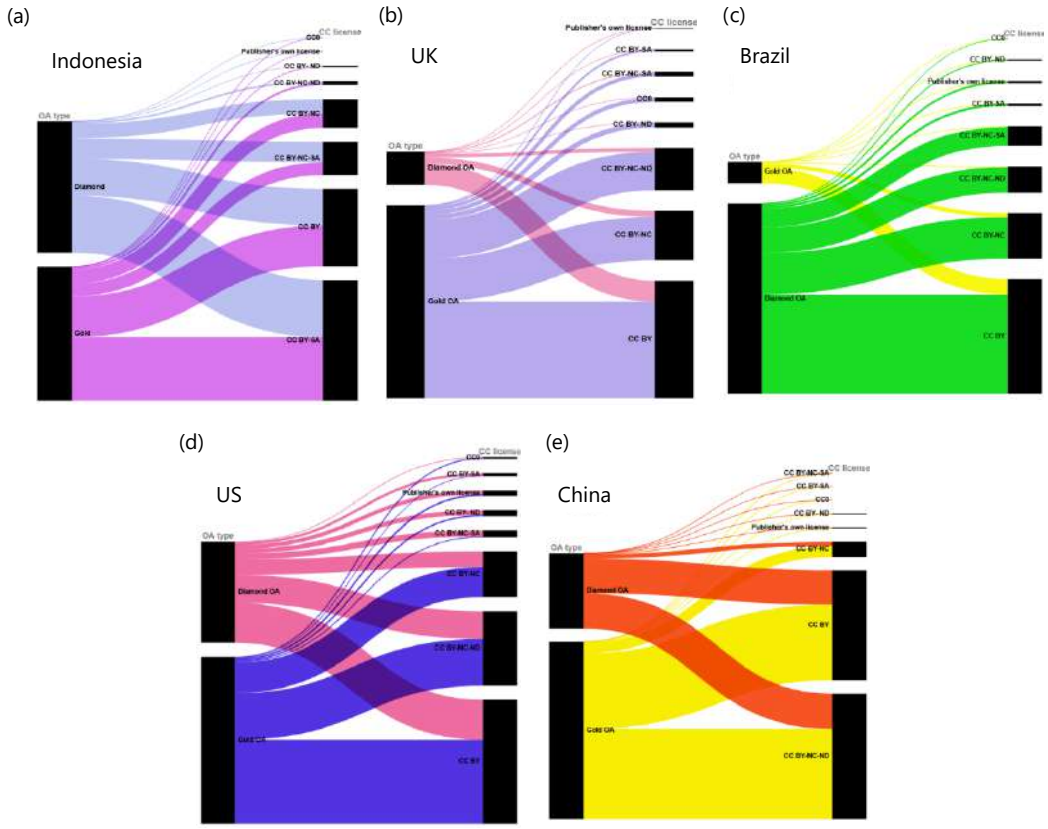


Fig. 4(a-e): Alluvial diagrams show the correlation of the OA types and CC license of the 5 countries, (a) Indonesia, (b) The UK, (c) Brazil, (d) The US and (e) China

The results of this study show that as of September 2025, there are 501 journals (Gold OA vs Diamond OA: 369 vs 132) indexed by DOAJ in China. The total number of DOAJ-indexed journals in China is less than the UK, the US, Brazil, and Indonesia. According to the solutions released by "Blue Book on the Development of China Science and Technology Journals (2024)"[10], China's scholarly journals, especially Chinese scientific and technological journals, have launched their own solutions, forming the self-operated journal websites, practicing free access to full-text articles, and relying on external platform dissemination channels to provide full-text articles, opening up a parallel publishing model of OA and subscription for the same journal. For Bronze journals, the copyright licenses are always unclear, and the description of the rights for readers to use is ambiguous. For example, a Bronze OA journal with no CC license but provides free download services does not represent that the journal discloses the scope of copyright using scope, including the derivatives in any form like adaptation, translation, annotation, etc. Therefore, it could be deduced that the development of OA in Chinese journals has its own characteristics, but the license to use the article and information transparency by DOAJ are worth learning from. Besides, no matter the Gold OA or Diamond OA model, either one is better than Bronze OA.

Types, applications, and suggestions of the CC license: The CC license includes, namely, attribution (BY), non-commercial use (NC), no derivatives (ND), and share alike (SA). At present, the CC license has been updated to version 4.0, which includes 7 CC license: CC BY, CC BY-NC, CC BY-NC-ND, CC BY-NC-SA, CC-BY-ND, CC BY-SA, and CC0. CC BY-NC-ND is also the strictest license type. The CC licenses most commonly used by China's journals included in DOAJ are CC BY-NC-ND, accounting for 51.7% (259/501), which is lower than the data released before[11]. The CC BY-NC-ND is the strictest CC license; derivatives and commercial use are prohibited. Journals restrict commercial use and prohibit authors or third parties from interpreting works before publication (adaptation, translation, annotation, editing). The second most commonly used are CC BY and CC BY-NC, accounting for 17.72 and 8.54%, respectively. Normal re-use is allowed in each CC license; only the commercial use is prohibited in CC BY-NC and CC BY-NC-ND.

Table 6: The characteristics analysis of CC license and languages of OA journals in Indonesia

CC license	Diamond	Gold	English	Indonesian	Arabic
CC BY	354	393	522	521	29
CC BY-NC	140	139	216	186	14
CC BY-NC-ND	18	20	32	22	1
CC BY-NC-SA	198	123	229	243	13
CC BY-SA	553	614	896	839	70
CC BY- ND	6	9	32	22	1
CC0	0	0	0	0	0
Publisher's own license	0	0	0	0	0

Academic journals strictly prohibit submitting multiple manuscripts, and many journals do not accept derivative works. In recent years, China's scholarly journals have gradually been included in international databases, either in full-text or abstract form. Therefore, journals that publish derivative works (especially translated works) may be included in the same database as journals that publish the original text, resulting in duplicate publications, and malpractice might occur. Therefore, it is recommended that China's OA journals either adopt the CC BY-NC-ND license to prohibit authors from derivative works or adopt CC BY to fully open the original work.

Besides, journals with preprints usually publish their papers online promptly before their official publication, expanding the dissemination of the papers and the influence of the journal. For such OA journals, it is recommended to use CC BY-SA or CC BY-NC-SA licenses.

In addition, for journals in Indonesia, many journals have bilingual publishing in English and Indonesian. In addition, Arabic language journals also account for a certain proportion of OA journals in Indonesia (Table 6).

For Brazil, the proportion of Portuguese language journals and bilingual journals in Portuguese and English is relatively high, so for journals that use CC BY-NC-ND and CC BY-ND, it is important to note the prohibition of derivation.

Superiority of a journal applies to DOAJ: The former researchers demonstrated that the OA model is beneficial for the dissemination of academic achievements, improving the transparency of the journals, enhancing their visibility, and international influence[11-15]. It is helpful for a journal to establish OA strategies by referring to the inclusion standards of DOAJ: (1) It conforms to the development requirements of open science, promotes the rapid dissemination of knowledge, thereby enhancing the influence of the journal. (2) The DOAJ is the world's largest OA database, with a large number of journals and users. It might gain more exposure and enhance the visibility of authors and journals. (3) The process of applying for DOAJ can help the journal improve the creation of the policies (including but not limited to OA statements, OA systems for journals, peer review policy, editorial policy, ethical statement, academic misconduct statements, etc.) and build an international journal's website to achieve transparency in journal information[14]. (4) The adoption and implementation of a CC license by a journal can clarify its copyright regulations and clearly display the scope of users' rights and obligations.

The DOAJ helps OA journals standardize their policies and clarify the scope of OA. Even if journals do not apply to DOAJ, they can still benefit from DOAJ.

Develop OA strategies that are in line with the characteristics of the journal itself: The types of OA include Gold OA, Diamond OA, Green OA, Bronze OA, and Hybrid. Different types of OA journals have varying degrees of openness in publishing papers, agreements on copyright usage, and Article Processing Charges (APCs). Among them, Golden and Diamond OA journals have clear provisions on author copyright

retention, transfer, and third-party licensing. The main difference between Golden OA and Diamond OA is whether the journal charges APC. Bronze OA does not declare the CC license. Hybrid journals allow authors to choose whether the publication type is a subscription model or an OA model[13]. Whether journals adopt OA model and which OA type to adopt should be in accordance with the characteristics of the journal itself, such as Gold OA, Diamond OA, etc[5]. The DOAJ only includes journals with complete OA (including Gold OA and Diamond OA journals), and does not include hybrid or delayed OA[13]. At present, Bronze OA has the highest proportion in China's OA journals, while Gold OA, Diamond OA, and hybrid journals have a relatively small proportion; In contrast, Brazil has the highest proportion of Diamond OA journals, while the UK and the US have the highest proportion of Gold OA journals. Although Bronze OA journal allows readers to download papers for free, the journal does not have clear license to use. With the development of journal publishing, the number of Bronze OA journals will gradually decrease, for which, it is recommended to clarify the relevant details of license to use, in order to standardize the scope of rights to use for anyone else. Gold OA and Diamond OA are two important types of DOAJ. The difference between Gold OA Journal and Diamond OA Journal is whether they charge APC. The APC generally includes various expenses such as online manuscript processing systems or fees for peer review, language polishing, chart production, editing, typesetting, proofreading, preprint publishing, etc.[14], post-publication services, long-term archiving, and others. In China, journals (especially Chinese-language journals) usually refer to APC as publication fee, which can also include the fees mentioned above. At present, newly established English journals and journals with strong support from their organizers do not require APC. Most of these journals are jointly published by domestic organizers and international publishing institutions. The Diamond OA model helps journals attract sources of articles, thereby enhancing the journal's influence. Anyway, the collection of APC by Gold OA journals should be within a reasonable range. When the fees are too high, it may deter authors and potentially lead to the development of predatory journals[15].

Transparency and policy-making: Journals should comply with their own CC licenses, clarifying the scope of rights and obligations of publishers, authors, and users. At the same time, the author's copyright retention should be clearly defined, such as the right of attribution, the right to protect the integrity of the work, etc. The transfer of the copyright of the compiled work and the right of information network dissemination should be clearly stated in the copyright transfer agreement. The Bronze journal with the highest proportion of OA in China is characterized by unclear copyright licensing agreements and a lack of a CC license. Therefore, implementing CC license that complies with their own standards or clarifying OA statements is of great benefit to OA journals.

Strictly implementing the peer review policy is one of the most important means to achieve open science. OA is an important component of open science. Open science includes open data, open peer review, and open academic achievements. Strictly implementing the peer review policy in OA journals can help improve their academic quality and promote the development of open science. In addition, a strict and transparent peer review policy is an important symbol of OA journals[16].

The DOAJ first introduced the Principles of Transparency and Best Practice in Scholarly Publishing in December 2013, aimed at helping DOAJ identify the quality of academic journals. The journal website should display basic information about the journal, such as the journal introduction, aim and scope, sponsor, publisher, editorial board, CC license, copyright information, peer review policy[17], APC and other fee information (including exemption policies, etc.)[5].

Transition of business models: The number of journals included in DOAJ is constantly changing, and some journals have transitioned from traditional subscription models to OA. Although the OA model is of great significance in enhancing the influence of journals, journals should also achieve sustainable development in terms of operations. The change in subscription mode will affect the incomes of journals,

but due to the short half-life of scientific journals, achieving rapid display for the research results is an important task for scientific journals. The proportion of subscription revenue to the total revenue of academic journals is usually not large. For the vast majority of Gold OA journals, APC is the main source of the journal's profit point. On the contrary, the Diamond OA model can be used to attract authors to submit articles. After the journals have been indexed in databases such as ESCI, SCIE or SSCI[18], or already have a continuous and stable source of high-quality manuscripts, the publishing model can be transformed into Gold OA to help the journal gain profits. In addition, Bronze OA journals can also be converted to Gold OA and Diamond OA journals by clarifying copyright agreements. The inclusion requirements of DOAJ for Gold OA and Diamond OA journals are worth learning from.

Besides, starting from Spring 2025, a new label was added in DOAJ, known as "Subscribe to Open" (S2O), which is a pragmatic approach for converting subscription journals to open access, free and immediate online availability of research, without reliance on either APC. By the end of September 30, 2025, there were 73 S2O journals indexed in DOAJ, of which 29 were German journals, 23 were from the US, and 21 were from the UK. We could look forward to more S2O journals being added in DOAJ.

CONCLUSION

At present, the number of journals included in DOAJ continues to rise, especially in many countries where the number of journals included still needs to be increased. The inclusion criteria of DOAJ are known as the gold standard for OA journals, but currently, DOAJ only includes Gold OA and Diamond OA journals, even S2O, and does not include journals with hybrid publications. By drawing on the inclusion evaluation system of DOAJ, it is helpful for the OA construction and development of journals. Adopting and implementing the CC license helps OA journals standardize the scope of rights to use for anyone. The OA model is beneficial for the dissemination of academic achievements and also enhances the visibility of journals; In addition, OA is an important component of open science, and OA journals should adopt specific OA models based on their own characteristics to adapt to the development of open science. This study analyzed the development status and characteristics of DOAJ indexed journals around the globe, including subjects, languages, CC licenses, peer review types, publishers, etc., and the differences of the OA journals published in Indonesia, the UK, Brazil, the US and China indexed in DOAJ were compared as well. Further study will focus on the APC distribution of Gold OA journals around the globe and S2O label. In short, OA infrastructure, CC licenses, DOAJ, repositories and other means facilitate the development of OA. DOAJ as one of the largest OA databases, provides quality filters, persistent metadata, and visibility, both for publishers, authors and for users.

SIGNIFICANCE STATEMENT

This study provides a comprehensive global analysis of Gold and Diamond OA journals indexed in DOAJ, offering empirical evidence on their distribution by subject, language, licensing type, peer-review model, and publisher characteristics. By comparing OA practices in Indonesia, the UK, Brazil, the US, and China, the study reveals national differences in OA development and strategic models. The findings highlight the importance of CC licensing, DOAJ indexing, and OA infrastructure in improving journal visibility, ensuring equitable access, and supporting open science practices worldwide.

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