Charting variety, scope, and impact of open access diamond journals in various disciplines and regions: a survey-based observational study

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Abstract
Purpose: The variety, scope, and impact of open access (OA) diamond journals across disciplines and regions from July 22 to September 11, 2020 were charted to characterize the current OA diamond landscape.
Methods: The total number of diamond journals was estimated, including those outside the Directory of Open Access Journals (DOAJ). The distribution across regions, disciplines, and publisher types was described. The scope of journals in terms of authorship and readership was investigated. Information was collected on linguistic diversity, journal dynamics and life cycle, and their visibility in scholarly databases.
Results: The number of OA diamond journals is estimated to be 29,000. OA diamond journals are estimated to publish 356,000 articles per year. The OA diamond sector is diverse in terms of regions (45% in Europe, 25% in Latin America, 16% in Asia, and 5% in the United States/Canda) and disciplines (60% humanities and social sciences, 22% sciences, and 17% medicine). More than 70% of OA diamond journals are published by university-owned publishers, including university presses. The majority of OA diamond journals are small, publishing fewer than 25 articles a year. English (1,210), Spanish (492), and French (342) are the most common languages of the main texts. Out of 1,619 journals, 1,025 (63.3%) are indexed in DOAJ, 492 (30.4%) in Scopus, and 321 (19.8%) in Web of Science.
Conclusion: The patterns and trends reported herein provide insights into the diversity and importance of the OA diamond journal landscape and the accompanying opportunities and challenges in supporting this publishing model.

Keywords
Access to information; Authorship; Data management; Diamond open access; Publishing
Introduction

Background/rationale
From June 2020 to February 2021, a consortium of 10 organizations undertook a large-scale study on open access (OA) journals across the world that are free for readers and authors, usually referred to as “OA diamond journals.” In other words, these journals have neither an author-side article processing charge (APC) nor a reader-side access fee. This study was commissioned by cOAlition S to gain a better understanding of the OA diamond landscape. In this article, only the landscape part of the results of OA diamond journal survey is presented.

Objectives
This study aimed to gain a better understanding of the OA diamond landscape within the scope of the survey of OA diamond journals. Specifically, we searched for information on the following parameters: the number of OA diamond journals and articles, distribution of OA diamond journals, journal size, scope, visibility of OA diamond journals in scholarly databases and indexes, and journal dynamics and life cycle.

Methods

Ethics statement
This study was based on a survey about journal publishing, the items of which included no sensitive personal information. No institutional review board approval was required. Participants agreed to voluntarily participate in the survey.

Study design and setting
This was a cross-sectional observational study based on a survey. From mid-June to mid-July 2020, we prepared an online survey listing 94 questions to collect data on various components of diamond journals, including their legal structure and governance, authorship, content and metadata, editorial quality assurance practices, technical framework, funding model, dissemination and readership, and challenges. The structure and questions of the survey are available in Suppl. 1. SurveyMonkey was used to manage the dissemination of the survey and the collection of responses. The survey was disseminated to all diamond journals identified in the Directory of Open Access Journals (DOAJ), 30 mailing lists, nine hosting platforms and aggregators, 10 partners and community websites, and several personalities and social media accounts to be shared worldwide. A crowd-sourced list of OA diamond journals (particularly those not included in DOAJ) was also used to disseminate the survey to specific journals.

Open from July 22 to September 11, 2020, the survey produced 2,605 “raw” events, including approximately 1,900 identifiable answers (with the name and email address of the respondent). Eventually, after further cleaning (deduplication, removal of fake answers), we collected 1,619 valid responses. Of the 94 questions, 21 were not asked to journals that declared being indexed in DOAJ because the corresponding data were already available there. To the question: “Is the journal already registered in DOAJ?,” 1,136 journals answered “yes” (skipping questions 8 to 29), 431 answered “no,” and 52 answered “don’t know.” Data were then extracted from DOAJ for the 1,136 journals registered in DOAJ and added to the final dataset to be analyzed. The individual responses were identified by unique numerical identifiers generated by SurveyMonkey.

Participating journals
We undertook a statistical analysis of several bibliographic databases, surveyed 1,619 journals, collected 7,019 free-text submissions and other data from 94 questions, and organized three focus groups with 11 journals and 10 interviews with hosting platforms. Furthermore, we collected 163 references in the academic literature and inventoried 1,048 journals not listed in DOAJ (Suppl. 2).

Variables
All items of the survey questionnaire were variables.

Data sources/measurement

Analysis of the free-text submissions
The survey received 7,019 free-text submissions. Unlike the other inputs, these elements are not pre-structured: the respondents were free to develop their ideas or to include observations that were beyond the scope of the question. Some of the free-text submissions could be deemed irrelevant. On the other end of the spectrum, 50–100 free-text responses were very detailed and therefore became more highly represented when the corpus of submissions was analyzed at the sentence or the statement level rather than at the text level.

Exploration of the corpus
The corpus was too large to perform a simple qualitative analysis. However, the corpus was too small to be appropriate for standard text mining techniques, such as comparisons of vocabulary or topic modeling. For various questions, it was possible to retrieve the main arguments using a syntax analysis with Spacy (https://spacy.io).

Quantitative analysis with the Spacy natural language processing tree
The methods were not limited to a formal dataset of word oc-
currences, but relied on a “semantic space” of words and sentences. Bidirectional Encoder Representations from Transformers (BERT) is an important novel application in computational linguistics that uses deep learning models to recover the semantic and syntax relationships within a corpus. We generated a semantic map of the sentences from the peer review challenges. The interactive version of the map can be accessed here: http://numapresse.org/divers/peer_review_umap.html.

A systematic assessment based on clusters
While the exploratory tools give an approximative assessment of the arguments presented by the respondents, they do not make it possible to extract valid statistics. To give a more systematic assessment, a semi-automatic method was used. Small, very consistent clusters (HDBSCAN method) were used as a starting point.

Databases
To be able to quantify various dimensions of the diamond OA landscape, beyond derivatives from survey results, various databases were consulted. The most important were DOAJ, the ROAD Directory of Open Access Scholarly Resources, and Crawford’s Gold Open Access (GOA) databases.

Literature review
Through a literature search, 160 references were collected, focusing particularly on OA business models. The literature review was used primarily to design the survey, prepare the focus groups, and analyze the answers collected. The references were stored in a Zotero library, which has been made available online.

Interviews and focus groups
Three focus groups of journals were organized: two in English and one in Spanish. There were 10 interviews of representatives from hosting platforms and infrastructures. Each focus group lasted for 2 hours. The participants were selected based on their free-text submissions to provide a representative selection of the diversity of diamond models.

The experimental journal checker used for the focus groups
All the focus groups and the interviews were conducted remotely using an interview guide (with two different versions: one for the journals and one for the hosting platforms). The guide was not used as a constraining form but as a resource for potential questions and suggestions depending on the course of the discussion.

Complementary studies
In parallel, SPARC Europe conducted a study on Scoping Open Science Infrastructures in Europe that provided complementary information about the services and hosting platforms OA journals rely on.

Complementary study led by the Center for Sociology of Innovation
Finally, this study will be followed by a complementary study led by the Center for Sociology of Innovation to follow up recommendations with a complementary study to model operational funding scenarios. This will serve to transform the recommendations and action plan into possible concrete funding and support schemes and to test them against the actual capacity of the different stakeholders to implement them. More details on the setting and measurement methods can be found in the preprint available at: https://doi.org/10.5281/zenodo.4558704.

Bias
Different circumstances (the scope of the organization funding the study, the focus of the call for tender, and the composition of the consortium) influenced the collection of information, particularly in terms of geographic representativeness. Section 1 below gives details about the geographical biases of our dataset, compared to the geographical distribution that can be found in other databases. In addition to geographical bias, there may have been other biases in the responses due to journals’ motivation to participate in the survey or not. For instance, journals may have decided to participate to demonstrate their viability, or conversely, to highlight their needs for additional support.

Fig. 1. Overlap of journals in Directory of Open Access Journals (DOAJ) and ROAD. Source: Bruns et al. [1].
Study size and statistical methods
Study size estimation was not done because this was not a randomized experimental study, but a survey with voluntary participation. Descriptive statistics were applied for the interpretation of the results.

Results

Number of OA diamond journals and articles

How many OA diamond journals have we identified in the world?

Table S1 shows various estimates, based on the different sources and criteria these databases use. According to the ISSN Gold list from Bielefeld (ver. 4.0), there is a substantial overlap between DOAJ and ROAD journals (Fig. 1) [1]. If one assumes that the distribution of APC versus non-APC journals in the part of ROAD that does not overlap with DOAJ is the same as in DOAJ (at 73% OA diamond; Table S2), we could estimate the total number of OA diamond journals to be $0.73 \times 28,400$ (ROAD-only) + 10,194 (DOAJ) = 30,926.

Out of 382 journals listed in ROAD but not in DOAJ, between 23.8% and 65% are OA diamond. The lower figure of 23.8% includes journals that explicitly state that they do not levy APCs. The higher figure of 64.7% includes journals that do not provide data on whether they have APCs (Fig. 2).

In addition, 19% of journals are not active OA journals be-

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Fig. 2. Business models of a sample (n=382) of journals in ROAD but not in Directory of Open Access Journals (DOAJ). OA, open access; APC, article processing charge. Source: Manual check of websites of journals in the ROAD sample.

Fig. 3. The overlapping sets of Directory of Open Access Journals (DOAJ) and survey journals in the full journal landscape. Numbers rounded to the nearest hundred. APC, article processing charge. Sources: DOAJ and survey.

Fig. 4. Open access journals by year of addition to Directory of Open Access Journals (DOAJ). Source: DOAJ.
cause they have ceased publishing, are a closed/subscription journal, or are unfindable. The revised total estimate of OA diamond journals (with an ISSN) is, therefore, somewhere between $0.238 \times 28,400 + 10,194 = 16,953$ and $0.64 \times 28,400 + 10,194 = 28,569$. The overlapping sets of DOAJ and survey journals in the full journal landscape are presented in Fig. 3.

How has the number of OA diamond journals developed over time?

Fig. 4 shows the development of DOAJ journal numbers over time, using the year the journal was added to DOAJ. There is usually a time lag between a journal being established as OA or converted to OA, and being accepted by DOAJ, so many journals will be older than this graph suggests. This graph ex-

![Fig. 5. Open access diamond journals by year of addition to Directory of Open Access Journals (DOAJ). Source: DOAJ.](image1)

![Fig. 6. Article processing charge-based open access journals by year of addition to Directory of Open Access Journals (DOAJ). Source: DOAJ.](image2)
cludes journals that have been removed by DOAJ. The 2020 data only contain information until early June 2020. When looking at just the OA diamond journals, we see a similar pattern (Fig. 5).

The development over time is strikingly similar for both OA diamond and APC-based journals (Fig. 6). There was strong growth until 2017, except in 2014, when the DOAJ reapplication process started and many resources were spent on that. Both the number of journals admitted and the number of journals removed have grown over the last 3 years, resulting in an overall growth in DOAJ data (Fig. 7). Much content has been made available that dates from before the journal was added to DOAJ (Fig. 8). Obviously, some older journals have performed a retrospective digitization of content. Because of the inherent ambiguity in the question, DOAJ has removed this field from their current application form and metadata [2].

How many articles are published by OA diamond journals in total?
Based on the numbers for 14,368 DOAJ journals, partially from Crawford’s GOA (5) (https://waltcrawford.name/), and partially counted manually, and using the annual average number of articles per journal for the years 2017–2019, we estimate an annual production of 356,000 articles per year in 10,449 OA diamond journals and 453,000 articles per year in 3,919 APC-based journals. Almost half of the journals in our survey also contain book reviews, and substantial numbers also publish conference proceedings and opinion pieces (Fig. 9).

What is the number of articles in OA diamond journals over time?
It is also interesting to look at the change in article numbers over time. Crawford’s GOA (5) data set contains data for the years 2014–2019 for journals in DOAJ at the end of 2019 (Fig. 10). OA diamond journals show a continuous, but slowing, growth in article numbers between 2014 and 2018 and a decline in 2019. APC-based journals, in contrast, show a continuous and accelerating growth over the whole period. A slow de-
cline in the share of OA diamond journals in DOAJ is observed between 2017 and 2018, with a more marked decrease in 2019.

Distribution of OA diamond journals

Distribution of OA diamond journals by region

It is by now common knowledge that the phenomenon of OA diamond journals is not equally strong in all parts of the world, with Latin America quoted regularly as having a strong OA diamond tradition [3]. In DOAJ, of the 11,000 OA diamond journals, about 45% are published in Europe and 25% in Latin America (Fig. 11, top left). The remaining quarter originates from other world regions, with Asia taking the largest share and a surprisingly small number of journals based in the US and Canada. Europe’s share of OA diamond journals in DOAJ, though large, is still relatively weaker than its share of APC-based OA journals (Fig. 11, top right), mainly due to the large number of those journals based in Western Europe.

The journals from this survey that are not listed in DOAJ (Fig. 11, bottom right) are even more strongly characterized by a very large share of Western Europe, and smaller shares of Latin America and Eastern Europe, at least compared with DOAJ. Fig. 12 shows OA diamond and APC-based open access models in DOAJ by world region. Western Europe has the largest proportion of APC-based journals, together with Africa, at around 45%. The US and Canada follow with 37%, and then Asia with 29%. The global average is 27% APC-based and 73% OA diamond journals.

Distribution of OA diamond journals by discipline

Crawford’s subject classification from GOA (5) was applied to both DOAJ and survey data to group journals into three subject groups: humanities and social sciences (HSS), medicine, and sciences. Comparing the OA diamond journals in DOAJ (Fig. 13, top left) by discipline with the APC-based journals (Fig. 13, top right) showed a dominance of HSS journals among OA diamond DOAJ titles, whereas HSS is the smallest
group of disciplines among APC-levying journals. That same HSS-prevalence is found in the OA diamond journals of the survey (Fig. 13, bottom left and right). The shares of APC and OA diamond models are markedly different in the three disciplinary groups (Fig. 14).

**Distribution of OA diamond journals by publisher size and type**

OA diamond journals show a strong skew towards the very small publisher size brackets (Fig. 15), with a large majority of journals issued by publishers with five or fewer journals, and often even just a single one. In certain ways, publisher size is related to publisher type. The publisher types in the OA diamond sector (Fig. 16) are characterized by a large (>70%) share of university-owned publishers, including university presses. Fewer than 20% of OA diamond journals are published by commercial and non-commercial OA publishers or traditional publishers, which together publish almost 60% of APC-based journals.

**Journal size**

**OA diamond journal size, contrasted with APC-based journals**

The annual average number of articles per journal in DOAJ for the period 2017–2019 is 34 for OA diamond journals and 55 for APC-based journals. The corresponding medians are
23 and 25, respectively. In DOAJ, the majority of OA diamond journals (54.4%) publish 24 or fewer articles per year; only 33.4% of APC-based journals have a similar size (Fig. 17 and Table S3). On the other end of the scale, only 0.2% of OA diamond journals publish 500 or more articles per year, versus 3.4% of APC-based journals.

When analyzing the data on the number of articles by journal size brackets (Fig. 18), the number of articles appearing in very small journals (up to 10 articles per annum) is negligible for both APC-based and OA diamond journals. The data (Table S4) suggest the same kind of distribution, skewed toward the lower size brackets, and even somewhat more than the DOAJ data.

OA diamond journal size by region

Looking more closely at OA diamond journals’ annual number of articles published by geography and size (Table S5), we see that Asia, Australia/New Zealand, United States/Canada, and Western Europe have more journals in the smallest size group (0–24 articles) than the average. Eastern Europe, Latin America and the Middle East have more medium-sized journals than the average. The United States/Canada and Western Europe have more of the largest journals, with over 500 articles, than average, although the absolute numbers are small for this group.

OA diamond journal size per discipline

Applying Crawford’s subject classification from GOA (5) to the more recent DOAJ data used in this study, we can group journals into three subject groups: HSS, medicine, and sciences. The average HSS OA diamond journal publishes 27 articles per year (median, 20), science journals 43 (median, 23)
and medicine 47 (median, 33), for the period 2017–2019 (Table S6).

**OA diamond journal size by publisher type**
In his GOA (5) database, Crawford also classifies publishers into four categories: OA publishers (publishing only OA), societies (including associations and government agencies), traditional publishers (publishing both OA and subscription journals), and universities (including colleges and educational and research institutes). Using the same classification for jour-
nals not in Crawford’s data, the OA diamond journals in DOAJ are classified in Table S7.

Scope
The institutional, national, and international authorship of OA diamond journals
This information was elicited by asking about the proportion of a journal’s authors who are from the same country as the journal. The results (Fig. 19) show the importance of local journals, especially in Latin America and the Middle East, where over three-quarters of journals report that at least half of their authors are from the same country as the journal. Although many OA diamond journals have a national focus, the survey found that very few journals primarily serve authors at the institution the journal is associated with (Fig. 20).

National and international readership of OA diamond journals
The international orientation of many OA diamond journals is shown in Fig. 21. For HSS and medicine, approximately equal numbers of OA diamond journals report a more international orientation as do a more national orientation, and
Impact of open access diamond journals

Fig. 21. Share of journals stating their readership is mainly inside or outside their country (by region and discipline of the journal). Source: Survey Q80 (1,274 regions, 1,202 disciplines).

Fig. 22. Percentage of open access (OA) diamond and article processing charge (APC)-based journals using one language or two or more languages. Source: Directory of Open Access Journals (DOAJ).

Fig. 23. Percentage of open access diamond journals that reported publishing in one language or two or more languages. DOAJ, Directory of Open Access Journals. Source: Survey Q18.

the same is true for multidisciplinary journals.

Publishing language diversity
Table S8 shows all languages mentioned by more than 100 journals after the harmonization of the data. English is the most common language and is more important for APC-based journals than OA diamond ones. Spanish, Portuguese, and French play a much more important role in OA diamond journals than in APC-based ones. Generally, this holds for most languages other than English, with Ukrainian and Per-
sian as the notable exceptions, which, unlike most other languages, play an equally significant role in both models. A somewhat different picture arises from the survey data on accepted languages (Table S9). Many journals use more than one language, though two-thirds appear to publish in just one language (Fig. 22 and Table S10). There is a clear difference between OA diamond journals and APC-based journals in DOAJ, with 14% of APC-based journals and 38% of OA diamond journals being multilingual. Among survey respondents, the proportion of multilingual journals is even higher than in DOAJ (Fig. 23 and Table S11). Of the DOAJ journals included in the survey, 48% are multilingual (versus 38% of all OA diamond journals in DOAJ). Of the survey’s non-DOAJ journals, 60% are multilingual. Finally, from the survey data on the number of languages accepted, we find that among journals not in DOAJ, an impressive 14% accept manuscripts in four or more languages (Table S11).

Visibility of OA diamond journals in scholarly databases and indexes
The survey asked journals to indicate the databases and indexes where they are indexed, such as DOAJ, multidisciplinary bibliographic databases, regional databases (for Latin America), and library discovery services. The results are presented in Fig. 24.

Journal dynamics and life cycle
Journal age and pathways to OA diamond
The survey collected information on the year of the journal’s creation, the year the journal first became available online, the year it was made available as an OA journal, and the year it was made available as an OA journal without charging authors (Fig. 25). The results show that while older journals often started in print, almost all OA diamond journals have been OA diamond from the time they became available online.

Developments in article volume
The survey asked journals to indicate how the number of articles published per year has evolved over the last 5 years (Fig. 26). Specifically, it asked: has article volume been increasing, declining, remaining constant, or fluctuating? Overall, almost three-quarters of journals reported constant or increasing article volume, which can be taken as an indication of journal health and stability. It appears that smaller journals (fewer than 25 articles/year) are less stable than larger journals. Journals that currently have between 25-100 articles per year are
usually on a growing trajectory, with over 50% of these journals reporting an increase in the annual number of articles over the last 5 years (Fig. 27). No significant differences were reported in the stability of OA diamond journals across disciplines (Fig. 28) except in medical journals.

**Discussion**

**Key results**

A wide archipelago of relatively small journals serves diverse communities. The number of OA diamond journals is high (estimated at 29,000) but only a third are registered in DOAJ. OA diamond journals generally publish fewer articles than APC-based ones (356,000 per year compared to approximately 453,000). Since 2018, the share of diamond journal articles has been dwindling, which coincides with an increase in articles in APC-based journals. The OA diamond sector is diverse in regions (45% in Europe, 25% in Latin America, 16% in Asia, 5% in the US/Canada) and disciplines (60% HSS, 22% sciences, 17% medicine). In Europe, more than half of these journals are based in Eastern European countries. Most OA diamond journals are small, publishing fewer than 25 articles a year. OA diamond journals serve mainly a national authorship (in all disciplines, including sciences and medi-
cine) but disseminate their output to a large international audience. OA diamond journals are much more multilingual (publishing in several languages) than APC-based ones (38% compared to 14%). Almost all OA diamond journals have been OA diamond since they became available online.

**Interpretation**

There are almost at least 17,000, but likely up to 29,000, OA diamond journals, including journals that have not considered or succeeded in registering with DOAJ. The present data provide more in-depth insights only for OA diamond journals in DOAJ. It is estimated that OA diamond journals publish around 8%-9% of the total number of scholarly articles, and APC-based OA journals around 10%-11%. The share of OA diamond articles in all OA journals has declined since 2017. Compared to APC-based journals, OA diamond is solid in Eastern Europe and Latin America, and weaker in Western Europe. Over half of OA diamond journals are found in HSS. Within those disciplines, a large majority of OA journals are OA diamond, while in medicine, about half of full OA journals are OA diamond.

Most OA diamond journals are relatively small, but not extremely small. This is markedly different from APC-based OA journals, where most articles are published in large or very large journals. Most OA diamond journals are the sole journal of their publisher or have a publisher with just a few journals. Most of these publishers are university-based. Though many OA diamond journals have a national focus in terms of authorship, their readership is often international. The survey found that the number of journals that primarily serve authors at the institution is very low.

While English is the most common language, this tendency is more notable for APC-based journals than for OA diamond ones. Unlike most APC-based journals, many OA diamond journals accept manuscripts in multiple languages. Almost all OA diamond journals have been OA diamond since they became available online. Only a tiny proportion switched to an OA model after being available online as a subscription journal. Very few have switched from an APC-based OA model to OA diamond. Almost three-quarters of journals reported constant or increasing article volume, which can be taken as an indication of journal health and stability.

**Limitations**

This study was based on a survey of the editors or other corresponding persons of OA diamond journals. Attrition of participation is a major issue. This problem is not limited to the free-text; it affects all the fields of the survey that could not be recovered from the DOAJ since the respondents could skip a question for a variety of reasons, either because they were not interested or because they did not have time. Because only the status of journals and opinions of persons who voluntarily participated in the survey were analyzed, this was not a randomized experimental study. There may have been sampling bias due to the limitation of voluntary participation.

**Generalizability**

Although this was not a randomized study, the results of this large-scale survey may be able to provide information on the current landscape of OA diamond journals in the world.

**Conclusion**

OA diamond journals are very numerous, relatively small, often published by small university-based publishers, strong in HSS but important in other disciplines as well, and use the diamond model right from the moment of becoming accessible online. The above results indicate the importance of OA diamond journals. They also point to the main dimensions to reckon with when fostering OA diamond journals: their geographical and language diversity, large number and often smaller size, and their publishers’ size.

**Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

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**Data Availability**

Supplementary files are available from: https://doi.org/10.7910/DVN/HVGNGY

Dataset 1. Raw response data from participants of the survey containing 94 questions on OA diamond journals’ status from June 2020 to February 2021 without identifying information and without free-text answers (CSV). This includes, for some questions, data from DOAJ for journals present in that database.

Dataset 2. Readme text with the variable list for the survey data file (TXT)

**Supplementary Materials**

Supplementary files are available from: https://doi.org/10.6087/kcse.277

Suppl. 1. Survey form of 94 questions in PDF format for open access (OA) diamond journals’ status from June 2020 to February 2021.

Suppl. 2. List of journals and platforms consulted for the survey on open access (OA) diamond journals’ status from June 2020 to February 2021.

Supplementary tables

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