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Training in open access for doctoral students: results of a survey of current and recent students and supervisors

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Abstract

Introduction. This study aimed to understand the extent to which doctoral students receive training relating to open access publishing, and the form of that training.

Method. An international online survey of 1,569 current and recent doctoral students and supervisors was undertaken. Questions covered the extent and nature of training in open access offered to doctoral students, sources of respondents' open access knowledge, and their perspectives on open access.

Analysis. Descriptive statistical analysis was conducted with some non-parametric tests. Free-text data were thematically analysed.

Results. The large majority of current and recent doctoral students and supervisors indicated there was no mandatory open access training at their institutions. More than half of respondents thought they had good or excellent understanding of open access, with those who had completed training more likely to highly rate their understanding. Only 27% of respondents felt the level of training offered was sufficient. Respondents suggested that institutions could take further action to support understanding of open access.

Conclusion. There is a need for institutions to develop further training in open access. Researchers who undertake training in report a better level of understanding of open access and place more importance on it as a factor in selecting a journal.

Introduction

Open access can best be thought of as a suite of approaches to disseminating research outputs that ensures that access to those outputs is free to anyone. Open access is now a well-established part of the scholarly communications landscape, and most active researchers will be at least familiar with the term. Familiarity with the concept, however, does not equate to a true understanding of the complexity of open access in practice. This complexity manifests itself for researchers in a number of ways. A shifting and expanding open access journal market can lead to doubts about the quality and credibility of open access journals, especially with the risks associated with publishing in predatory journals being ever more clearly communicated to researchers by libraries and research offices (Wakeling et al., 2019). Publishing in open access journals often requires payment of an article processing charge (APC), meaning researchers must investigate institutional funding schemes or decide whether research funders will approve the use of their funding for this purpose. Furthermore, traditional subscription journals are increasing likely to offer hybrid open access options (Zhang et al., 2022). While these, too, often require payment of an author processing charge, increasingly there are opportunities for authors to take advantage of Transformative or Read and Publish agreements negotiated with publishers by their institutions, or consortia to which their institutions belong (Borrego et al., 2021). These agreements can be complex; many do not include all titles produced by a publisher, and some are capped. In addition to these challenges, the Green route to open access through the deposit of a manuscript in an institutional or other repository can also pose difficulties. Authors not only have to work out which version of their article can be deposited, but also determine publisher embargo periods (which can vary across titles for the same publisher), and negotiate repository ingestion processes and systems (Fry et al., 2015). And this is not to mention the need to be familiar with requirements of funder and institutional open access policies, and other elements of the scholarly communication ecosystem that impact on open access publishing decisions; different forms of journal and article metrics, potential open access citation advantages, the relationship between preprints and open access, the role of research networking sites such as ResearchGate and, of course, institutional research productivity measures.

Given this complexity, it is reasonable to wonder whether researchers in general, and early career researchers in particular, are receiving sufficient training and guidance relating to the open access publishing and dissemination of research outputs. As the open access movement seeks to further advance its cause and increase open access performance globally, the challenges faced by researchers in navigating the issues outlines above surely stand as a major potential hurdle. We have investigated this problem in the context of doctoral students and attempted to answer the research questions:

- What forms of training in open access have current and recent doctoral students received as part of their doctoral studies?
- To what extent has this training informed their understanding of open access, and influenced their publishing practices?
- What sources, other than formal training, inform authors' understandings of open access?
- To what extent do researchers believe there is a need for increased formal training in open access?

To address these questions, we utilised a survey method, developing an online questionnaire that was distributed to researchers around the world.

We recognise that open access is just one facet of the much broader concept of open scholarship, which encompasses a number of other *opens*; open data, open source, open peer review, open educational resources, etc. (Forster and Deardorff, 2017). We hope in the future to expand our research to cover these elements and situate discussions of open access within this wider framework. For this study, however, the aim was to undertake

exploratory and descriptive research on just open access. This enabled us to develop a research instrument that systematically investigated the issue of open access training for doctoral students, something that would not have been feasible had the questionnaire been designed to cover all aspects of open scholarship.

Literature review

Universities focus on ensuring their doctoral candidates are well prepared for a career in research on completion, having gained skills in the conduct of research as it relates to their discipline. And yet the research environment demands more. There are increased calls for open research, with an imperative for research to be disseminated through open access publishing and other means to increase impact (Morrison and Merlo, 2022, p. 179). Pontika (2015) has suggested that open access can offer an advantage for early career researchers in raising their profile as researchers and disseminating their research outputs (p. 1). Further, worldwide, many grant programmes require that outputs be made open access (Else, 2019). With doctoral students being encouraged to publish throughout their candidature (Australian Council of Learned Academies, 2016, p. 40; Barnett et al., 2017, p. 1447), an in-depth understanding of open access and its implications is essential.

According to a working group at the European Commission, it is important to ensure researchers are adequately trained during their doctoral studies and throughout their career (Carroll et al., 2017), and recommendations included a sound understanding of Plan S, incorporating open access publishing. Doctoral programmes at many institutions do not consistently include a coursework component that might cover open access publishing. Instead, formal training tends to focus on specific research competencies such as research methods, statistics, and software packages, grant writing, and academic integrity and ethics (Panchenko et al., 2021), rather than the principles of open science.

Some research has been undertaken to explore what formal training is in place to expand doctoral students' understanding of open access. For example, a study undertaken in 2019 looking at kinesiology doctoral students' perspectives of their research training across a number of areas, including publishing, found that almost all students surveyed had a "somewhat clear understanding" of research publishing practices in general (Boyce et al., 2019, p. 284) but the study does not specifically mention open access. A study of PhD training programmes in highly ranked French universities found that of the 922 training events identified, only thirty-three related to open access publishing (Schöpfel et al., 2019, pp. 6-7). Nevertheless, open access was the primary component in the open science training category. Ng et al. (2023) found that around one in three complementary, alternative, and integrative medicine researchers had received no training in open science, and only 18% had received training in the form of formal coursework or workshops. Panchenko et al. (2021) report that open science training was a low strategic priority for Ukrainian and other European universities (p. 7) and recommend the development of a course on "reproducible research" that would incorporate open access (p. 5). The desire to employ these principles is evident in a study by Read et al. (2022), which introduced open science practice, including open access, to undergraduate students in a professional practice course. This intervention led to an expression of intent to incorporate these skills into future research practices by 90% of the participants. These examples suggest that there is little regularity or consistency in delivery in a way that would fulfil the goal of the European Commission's Plan S (European Science Foundation, 2020), in particular their first objective to '*support different stakeholders, especially young researchers, in adopting open access…*' (Schmidt et al., 2016, p. 2).

Currently, open access training appears to be directed toward librarians, research administrative staff, or supervisors, rather than doctoral students and early career researchers. Librarians have been described as the *gate-openers* to open access publishing, through their pivotal role in information management and sharing (Boufarss and Harviainen, 2021) and

Frank et al. (2023) suggest librarians "well-versed in journal quality metrics" would be best placed to educate researchers (p. 7). The focus of Cole and Evans's (2014) study was increased training for library staff, who would then disseminate their learning to research staff and doctoral students. However, Rodriguez (2015) noted that while library staff have an increasing role in providing training for researchers, the librarians' ability to fulfil this role can be limited by a lack of opportunity for their own in-depth training. Cole and Evans's (2014) survey of professional services staff in the research office, library, IT services and academic research support teams (the Exeter project) found that only 11% of respondents had received any training across the range of *research data management* training identified. Yet, nearly half the respondents (121 of 284; 43%) identified *institutional repositories* and open access as an area in which they felt training was lacking.

One widely available resource, the FOSTER project, takes a train-the-trainer approach via bootcamps (European Union, 2014). To support librarians and others who deliver open science training in their own institutions FOSTER provides access to a regularly updated handbook, toolkit, online resources, and collaborative opportunities (Brinken et al., 2019, p. 6). Cole and Evans (2014) suggest that embedding open access training into existing training programmes for research staff highlights it as an '*integral part of the research environment*' rather than supplementary (p. 4). This view is echoed by Giustini et al. (2021) in their review focused on health sciences librarians. However, Giustini et al. also put out a strong call for further research into the type and target for existing training, as well as an evaluation of its impact (p. 556).

A survey by the European Commission (Carroll et al., 2017) for their Open Science Skills Working Group Report found that early career researchers know less about open science than more senior researchers (p. 8), yet many experienced researchers are still not aware of whether they are publishing in open access journals (p. 12). Schönbrodt (2019) reports that there is an enthusiasm from early career researchers to do open science, but there are concerns that this aspiration does not align with universities' methods of reporting research output (p. 1031). Schönbrodt discusses Ludwig-Maximilians-University Munich psychology department's mandatory courses on open science at undergraduate level, and notes that students' dissertations must describe which open practices are employed (p. 1031).

Numerous training resources pertaining to open access are available online, however, there remains a lack of formal training within a doctoral students' programme that would ensure students complete their training with a well-grounded understanding of the implications and benefits of open access publishing (McCallin and Nayar, 2012). It would appear that training delivered by supervisors alone may not meet the needs of their students, not least because of the often-problematic supervisory relationships with doctoral students (McCallin and Nayar, 2012, p. 66; Owens et al., 2020), which can be further compounded by a lack of cultural knowledge (Trudgett, 2014).

Method

Sampling and distribution

The intention was to gather data from researchers working in a diverse range of disciplines and geographic locations to develop a global perspective on the issue of open access training for doctoral students. While the primary focus of the study was to gather the perspectives of current or recent doctoral students, we could identify no simple means of obtaining contact details for just this category of researchers. However, we also recognised that researchers who had completed a doctoral degree some time ago may be currently supervising doctoral students, and therefore also have knowledge of current open access training practices. We were therefore able to use the Scopus database to generate a sample of corresponding author email addresses for articles published in 2021, stratified by discipline.

One issue with using Scopus to generate this sample is that, while Scopus supports the

export of search results, including corresponding author email address, at the time this study was conducted the export was limited to the first 2,000 search results (the limit is now 20,000). This is problematic because a search for all articles published in a given year in a particular Scopus subject area will yield many more than 2,000 results (for example, a search for journal articles with the Agricultural and biological sciences subject area published in 2021 produces 225,169 results). While there are a range of sorting options provided by Scopus (Author surname, Date, Citations, Source Title, Relevance), all of these risk the generation of a biased sample if only the first 2,000 search results are exported. This is because certain journals (in the case of Date, Source Title, Citations or Relevance) or authors from certain countries (in the case of surname) are much more likely than others to be included in the sample depending on the sorting approach used.

The solution we identified to this problem utilised the ScopusID: a unique 10-digit number that Scopus uses to identify authors and group their publications. The Scopus advanced search functionality allows for searches that limit results only to publications by authors with ScopusIDs that include a specified string of numbers. With some trial and error, we were able to identify the number of randomly generated digits that could be included in the search to limit search results to under the 2,000-result export limit. For example, for the Agricultural and biological sciences subject area, the use of the following advanced search query, incorporating a random three-digit number in the Scopus ID field ("AU-ID") generates 731 results:

> pubyear is 2021 AND (SUBJAREA(AGRI)) AND (AU-ID(*XXX)) AND (SRCTYPE(j)) AND (PUBSTAGE(final)) AND (DOCTYPE(ar)) AND (LANGUAGE(english))

For subject areas with fewer publications (e.g., Dentistry, Economics), two-digit random strings could be used.

Using this approach multiple searches and exports could be run to generate a large list of email addresses, with a controlled distribution of subject areas. As response rates to this type of unsolicited questionnaire are typically very low, we initially generated a list of 84,000 email addresses to which to send the questionnaire invitation. Email invitations were sent via Charles Sturt University marketing system in December 2022. However, this proved to be less than optimal: out of office replies and some correspondence with recipients showed that in most cases recipients' institutional IT systems had automatically tagged the email as spam or marketing. The result, therefore, was very low response rates (less than 1%). An additional list of 28,000 emails was then generated, with invitations to this list sent via SurveyMonkey itself in March 2023. This second batch of invitations received a higher response rate (circa 4%).

In total 112,000 email invitations were sent, representing 4,000 invitations for each of twenty-six Scopus subject areas, with the exception of Arts and humanities and Social sciences. For these two subject areas we sent double the number of invitations, as we considered these broader than other Scopus subject areas, and we wanted to ensure researchers in these disciplines were adequately represented in the data. In total 1,569 complete responses were received.

Questionnaire design

The SurveyMonkey tool was used to design and implement the questionnaire. The structure of the questionnaire was relatively complex, as different questions were asked of participants based on their doctoral degree status. This was necessary as we wanted to ask different questions of respondents depending on whether and when they had completed or were undertaking doctoral studies or had doctoral student supervisory experience. All respondents were asked five initial background questions in Section 1 of the questionnaire, covering their academic discipline, years conducting research, geographic location, and type of institutions in which they work. They were then asked to select one of the following doctoral degree statuses (with the explanatory text "By 'doctoral degree' we mean a doctoral research degree such as Ph.D, D.BA, Ed.D, D.M.Sc, D.Eng, etc.")

1. I was awarded a doctoral degree in 2015 or later.
2. I am currently studying for a doctoral degree.
3. I was awarded a doctoral degree in 2014 or earlier .
4. I do not hold a doctoral degree and am not currently studying for one.

Respondents who selected options 3 or 4 were asked an additional question to determine whether they had ever supervised a doctoral student at their current institution. SurveyMonkey's question logic function was used to customise Section 2 of the questionnaire based on responses to these questions. Table 1 shows the different response categories, and the questions asked of each category:

Doctoral degree status	Secondary screening question	Questions in section 2	Label in this paper (participant code)
Awarded a doctoral degree in 2015 or later	n/a	Questions asked about experience of both mandatory and optional open access training, whether this training was completed, who delivered the training, the form of the training (online or face-to-face; synchronous or asynchronous), and whether the respondent feels they received sufficient training in OA	'Recent doctoral students' (RG)
Currently studying for a doctoral degree	n/a	Same questions as above, with modified tense/grammar to acknowledge currency of study	'Current doctoral students' (CS)
Awarded a doctoral degree in 2014 or earlier	Has supervised a doctoral student at current institution	Same questions as above but modified to relate to open access training offered to current doctoral students in the respondent's discipline at their institution.	'Supervisors' (S)
	Has not supervised a doctoral student at current institution	No questions in section 2.	'Post graduate' (PG)
Does not hold a doctoral degree and not currently studying for one	Has not supervised a doctoral student at current institution	No questions in section 2.	n/a (NA)

Table 1. Questions asked in relation to doctoral status

Section 3 of the questionnaire was the same for all respondents and asked a series of questions about their experience of open access, including publishing in an open access journal, paying author processing charges (APCs), depositing Author Accepted Manuscripts in a repository, familiarity with institutional open access policies, and utilising *Read and Publish* agreements. Participants were also asked how important a factor open access was in their choice of journal for the last article they published. Finally, respondents were asked to rate their understanding of open access, to indicate the extent to which various information sources (e.g., colleagues, training, Web resources) had informed that understanding, and to express agreement or disagreement with four statements relating to institutional open access training. A final open-ended question asked for any remaining

comments about open access training for doctoral students.

Data analysis

Quantitative data analysis was undertaken using Excel and SPSS and produced primarily descriptive statistics, although the Mann Whitney U test was used to test the significance of differences between groups for some questions. Qualitative data collected in the open-ended questions were downloaded to Excel before being imported to NVivo to facilitate inductive coding. Coded data were then analysed using reflexive thematic analysis within an interpretivist framework (Braun and Clarke, 2022). In reporting qualitative findings, we have assigned IDs to respondents using the participant codes found in Table 1 to identify their status.

Respondent characteristics

Table 2 shows the distribution of respondents. They live in ninety-six different countries. Two-fifths of respondents live in Europe (40%), followed by 27% in North America, and 15% in Asia. The six countries with more than fifty respondents were USA (n = 327, 21%), Australia (n = 116, 7%), UK (n = 99, 6%), Canada (n = 71, 5%), Germany (n = 67, 4%), Italy (n = 66, 4%), and Spain (n = 63, 4%). The four major English-speaking countries are the top four in terms of the number of respondents. In terms of institutions where respondents work, as expected, most respondents were from university/college (n = 1,223, 78%). Subject distribution was relatively even for the three broad fields of Biomedical sciences (n = 551, 35%), Social sciences (n = 501, 32%) and Physical sciences (n = 407, 26%), but the number was notably lower for Arts and Humanities (n = 110, 7%). Half the respondent cohort (n = 781, 50%) received their doctoral degree (i.e., Ph.D, D.BA, D.M. Sc., D.Eng, etc.) in 2014 or earlier and, of these, 683 (44% of all respondents) stated that they currently or had recently supervised a doctoral student. About a third of respondents (n = 510, 32%) received their doctorate in 2015 or later. There were 207 (13%) current doctoral students among the respondents and 71 (5%) respondents did not have doctoral degree and were not studying for one.

Demographic	Item	*n*
Continent (Where you live)	Europe	630 (40%)
	North America	422 (27%)
	Asia	234 (15%)
	Australasia	131 (8%)
	Africa	88 (6%)
	South America	64 (4%)
Institution (Where you work)	University/college	1223 (78%)
	Research institute	150 (10%)
	Hospital	69 (4%)
	Other (please specify)	67 (4%)
	Government department	44 (3%)
	Commercial organisation	16 (1%)
Subject area	Biomedical sciences	551 (35%)
	Social sciences	501 (32%)
	Physical sciences	407 (26%)
	Arts and Humanities	110 (7%)
Doctoral education	Awarded a doctoral degree in 2014 or earlier	781 (50%)
	Awarded a doctoral degree in 2015 or later	510 (32%)
	Current doctoral student	207 (13%)
	No doctoral degree and not studying for one	71 (5%)

Table 2. Characteristics of respondents (n = 1,569)

There were 421 responses to the open questions from sixty-one different countries, with almost one quarter from the United States (n = 106), three times as many as the next group, who were from Australia (n = 37). Respondents also represented twenty-six different Scopus subject areas, with the top three including Social sciences (n = 84), Psychology (n = 39) and Agricultural and biological sciences (n = 33).

Open questions related to sources of information from which participants had gained their knowledge of open access (n = 273), and final comments that allowed them to expand on earlier responses or add new information (n = 332).

Findings

Mandatory training

We asked about any mandatory training for doctoral students (i.e., training that students are *required* to complete as part of their doctoral studies) from three groups of respondents:

- Current doctoral students: whether they have any mandatory training as part of their degree.
- Recent graduates (awarded their doctoral degree in 2015 or later): whether they undertook any

mandatory training as part of their degree.

- Supervisors (awarded a doctoral degree in 2014 or earlier and have supervised students): whether their current institution has any mandatory training.

The results are presented in Table 3. Only 14% of recent graduates answered that they were required to undertake mandatory open access training as part of their doctoral studies, with even fewer current students (9%) believing that such training was part of their current doctoral programme. A slightly higher proportion of supervisors (18%) stated that mandatory training was required for doctoral students in their discipline at their institution.

Mandatory training	Recent doctoral students	Current doctoral students	Supervisors	Total
Yes	71 (14%)	33 (9%)	121 (18%)	225 (14%)
No	425 (84%)	320 (87%)	451 (66%)	1196 (77%)
Don't know	12 (2%)	14 (4%)	108 (16%)	134 (9%)

Table 3. Existence of mandatory open access training in doctoral degrees (n = 1,555)

Table 4 shows the percentage of those who said they had mandatory training by subject area and continent. Physical sciences had the highest percentage (76, 19%) and Social sciences had the lowest (57, 11%). Africa (27%) and Asia (22%) had higher percentages of Yes compared to Europe (17%) and North America (6%). Australasia had the lowest percentage (5%). The percentage of Yes responses for some notable countries (all with more than forty respondents) are: Australia = 5%, UK = 16%, US = 6%, Italy = 26%, India = 23%, China = 17%.

Mandatory training		Yes
Subject area	Arts and Humanities (*n* = 110)	16 (15%)
	Biomedical sciences (*n* = 551)	76 (14%)
	Physical sciences (*n* = 407)	76 (19%)
	Social sciences (*n* = 501)	57 (11%)
Continent	Africa (*n* = 88)	24 (27%)
	Asia (*n* = 235)	52 (22%)
	Australasia (*n* = 131)	7 (5%)
	Europe (*n* = 629)	106 (17%)
	North America (*n* = 422)	27 (6%)
	South America (*n* = 64)	9 (14%)

Table 4. Mandatory training by subject and continent

A follow-up question asked about who delivers such training (Table 5). Respondents could choose multiple options for this question. Overall, slightly more than two-thirds of respondents (69%) said their school, department, or faculty oversaw the delivery of

mandatory training, followed by the library (27%) and research office (23%). This order was slightly different for the three groups of respondents. While the education unit (school, etc.) had the highest percentage for all three groups of respondents, for current students and recent graduates the library had a higher percentage than the research office.

Response	Recent doctoral students	Current doctoral students	Supervisors	Total
School/department/faculty	51 (72%)	22 (67%)	83 (69%)	156 (69%)
Library	21 (30%)	11 (33%)	28 (23%)	60 (27%)
Research office	11 (15%)	6 (18%)	34 (28%)	51 (23%)
Other	2 (3%)	1 (3%)	7 (6%)	10 (4%)
Don't know	0 (0%)	2 (6%)	3 (2%)	5 (2%)

Table 5. Who delivers the mandatory training? (select all that apply) (*n* = 225)

In terms of the form of the delivery of mandatory training (respondents could choose multiple options), overall, there was no one distinctly dominant form of training and the percentages were relatively close for face-to-face presentation (78%), online presentation (72%), and online resources (67%) (Table 6). However, there were differences between the three groups. Face-to-face presentation was clearly the common form for recent graduates (83%), while for supervisors the differences between the three forms were not as large, with online presentation at the highest percentage (93%). For current students, online resources were the most commonly identified form (91%), but the other two forms were not uncommon either, with 79% for online presentation and 61% for face-to-face presentation.

Mandatory training delivery	Recent doctoral students	Current doctoral students	Supervisors	Total
Face-to-face presentation or workshop	59 (83%)	20 (61%)	96 (79%)	175 (78%)
Online presentation or workshop	23 (32%)	26 (79%)	112 (93%)	161 (72%)
Online resources	15 (21%)	30 (91%)	105 (87%)	150 (67%)
Don't know	0 (0%)	1 (3%)	4 (3%)	5 (2%)
Other (please specify)	1 (1%)	1 (3%)	2 (2%)	4 (2%)

Table 6. What form does the mandatory training take? (select all that apply) (*n* = 282)

Optional training

We asked similar questions for optional training (i.e., training that one could choose to do) (Table 7). The availability of optional training overall (37%) was reported to be higher than that of mandatory training (10%), but so was the percentage of *Don't know* (28%) responses, which suggests lack of awareness among researchers at all levels about what is available in their institutions. Current students

had the largest percentage indicating that optional training was available in their institutions (46%), while the lowest percentage belonged to recent graduates (29%). When looking at subject area differences (Table 8), there was less variation. The lowest percentage was in Biomedical sciences (29%) and the highest was in Physical sciences and Arts and Humanities, each with 38%.

Optional training	Recent doctoral students	Current doctoral students	Supervisors	Total
Yes	147 (29%)	95 (46%)	271 (40%)	513 (37%)
No	246 (49%)	52 (25%)	178 (26%)	476 (34%)
Don't know	111 (22%)	58 (28%)	222 (33%)	391 (28%)

Table 7. Existence of optional training in doctoral degrees (*n* = 1,380)

Subject area	Yes
Arts and Humanities	42 (38%)
Biomedical sciences	160 (29%)
Physical sciences	153 (38%)
Social sciences	158 (32%)
Total	**513 (33%)**

Table 8. Optional training by subject area (*n* = 1,380)

Of recent doctoral students who stated that optional open access training was available to them, 65% said that they had completed this training. Unlike the mandatory training where the education unit (school, etc.) was the main provider of training, the highest percentage for provider of optional training belonged to library (56%), followed by school, department, or faculty with 42%. The variations between the three groups as shown in Table 9 were small.

Response	Recent doctoral students	Current doctoral students	Supervisors	Total
Library	83 (56%)	54 (57%)	149 (55%)	286 (56%)
Research office	36 (24%)	23 (24%)	71 (26%)	130 (25%)
School/department/faculty	66 (45%)	39 (41%)	110 (41%)	215 (42%)
Other	10 (7%)	3 (3%)	13 (5%)	26 (5%)
Don't know	0 (0%)	7 (7%)	16 (6%)	23 (4%)

Table 9. Who delivers the optional training? (select all that apply) (*n* = 513)

Face-to-face presentation or workshop was one of the delivery forms for 65% of respondents (Table 10). The second common form of delivery was online presentation (54%), followed by online resources (42%).

Optional training delivery	Recent doctoral students	Current doctoral students	Supervisors	Total
Face-to-face presentation or workshop	114 (78%)	47 (49%)	171 (63%)	332 (65%)
Online presentation or workshop	60 (41%)	64 (67%)	151 (56%)	275 (54%)
Online resources	47 (32%)	48 (51%)	118 (44%)	213 (42%)
Don't know	0 (0%)	11 (12%)	29 (11%)	40 (8%)
Other (please specify)	2 (1%)	2 (2%)	10 (4%)	14 (3%)

Table 10. What form does the optional training take? (select all that apply) (*n* = 513)

After checking about existing mandatory and available optional training, we asked respondents if they thought they have received or are receiving (in the case of current students) sufficient training in open access as part of their doctoral studies. About half (51%) believed the training was not sufficient; slightly more than a quarter (27%) thought it was sufficient; and 22% said they did not know (Table 11). Current students were more likely to believe that the open access training they are receiving as part of their degree was sufficient (34%) than recent graduates (24%). The percentage for supervisors was also slightly higher (26%) than recent graduates.

Sufficient open access training?	Recent doctoral students	Current doctoral students	Supervisors	Total
Yes	119 (24%)	69 (34%)	172 (26%)	360 (27%)
No	300 (60%)	100 (50%)	288 (43%)	688 (51%)
Don't know	80 (16%)	33 (16%)	184 (28%)	297 (22%)

Table 11. Do you believe doctoral students in your institution receive sufficient training in open access? (n = 1,345)

Open access and publication decisions

One key aspect of open access training is about making informed decisions about journals when publishing articles. Respondents were asked how important a factor open access was in such decisions (Table 12). It appeared that open access was the most important factor for those without a doctoral degree (M = 3.09) as 46% considered it very or extremely important, while for those with a doctoral degree this figure was 31% and for current doctoral students it was 35%. There are some subject differences, with the figure for Arts and Humanities being surprisingly high (40%) and close to that of Biomedical sciences (42%). The figure was the lowest for Social sciences (23%).

		Mean	Very or Extremely Important
Doctoral education	Current doctoral student	2.86	35%
	No doctoral degree and not studying for one	3.09	46%
	Awarded a doctoral degree in 2014 or earlier	2.73	31%
	Awarded a doctoral degree in 2015 or later	2.73	31%
Subject area	Arts and Humanities	2.94	40%
	Biomedical sciences	3.03	42%
	Physical sciences	2.83	32%
	Social sciences	2.50	23%
Total		**2.77**	**32%**

Table 12. Thinking about the last article you published, when deciding which journal to publish in, how important a factor was open access? (1 = not at all, 5 = extremely) (n = 1,512)

When comparing those who completed mandatory or optional open access training with those who did not, a Mann Whitney U test revealed a significant difference (U = 37,645, z = -4.217, p < 0.001); those who did the training were more likely to consider open access an important factor (M = 3.11, 40% very or extremely important) than those without training (M = 2.66, 29% very or extremely important).

Current understanding and its sources

Respondents overall rated their current understanding for open access as above average. The mean rating value of current understanding for respondents with different doctoral education as shown in Table 13 was

somewhat above 3 (mean of 1-5 Likert scale). The percentages of those who rated their understanding as good or excellent varied between 39% in the case of current students and 60% for those without a doctoral degree. The difference in understanding between those who did some mandatory or optional training and those who did not was found to be statistically significant using the Mann Whitney U test (U = 39, 274, z = -3.604, p < 0.001). Fifty-nine per cent of those who did training rated their understanding as good or excellent (M = 3.64), while this figure was only 44% for those without training (M = 3.39).

Doctoral education	Mean	Good or Excellent
Current doctoral student	3.71	39%
No doctoral degree and not studying for one	3.58	60%
Awarded a doctoral degree in 2014 or earlier	3.25	59%
Awarded a doctoral degree in 2015 or later	3.58	51%
All	**3.43**	**54%**

Table 13. How would you rate your current understanding of open access? (1 = No understanding at all, 5 = Excellent) (n = 1,509)

Responses to open questions suggested that many respondents had a general lack of confidence in their understanding of open access, with several stating this outright (e.g., RG13, RG159, CS253), and one respondent saying, '*I feel like I have a very limited understanding of open access and its benefit for research publishing. I don't even know if it is an important factor to consider when looking for publishers for research*' (CS268). Importantly, though, there appeared to be a lack of clarity around potential breach of copyright by using open access platforms, '*I typically upload final drafts of my publications onto open access Websites* (CS312).

Besides any training, various sources of information can contribute to researchers' understanding of open access, especially as they interact with publishers, funders and so on over the years. We asked them about sources of information for their current understanding (Table 14) and the most contributing source was Web pages or documents from outside their institution (M = 3.09). Other significant contributing sources included colleagues, information provided by a publisher when publishing research articles or books, and Web pages or documents from their institution. Both optional and mandatory training were at the bottom of the list in terms of their contribution to understanding, but this is likely a function of the small number of respondents who have completed formal open access training, In fact, for respondents who had completed mandatory open access training, 46.9% said that the training had informed their understanding to a large or very large extent, and the mean was 3.30, higher than any other source in Table 14.

Sources of Information	Mean	Large or very large extent
Web pages or documents from outside your institution (current or previous)	3.09	40%
Colleagues	2.87	30%
Information provided by a publisher when publishing research articles or books	2.86	33%
Web pages or documents from your institution (current or previous)	2.46	22%
Information provided by a publisher to support editorship/editorial board membership	2.46	24%
Information provided by research funders	2.15	19%
Doctoral supervisors	2.11	17%
Information provided by a publisher when acting as a peer reviewer	2.06	16%
Optional training (e.g., seminars/workshops) offered by your institution (current or previous)	1.86	12%
Optional training (e.g., seminars/workshops) offered outside your institution	1.80	12%
Mandatory training provided by your institution	1.54	7%

Table 14. To what extent have the following sources of information informed your understanding of open access? (1 = Not at all, 5 = To a very large extent) (n = 1,450)

In responses to open questions, participants described a range of additional avenues for accessing information about open access publishing, however by far the greatest source of information was through publisher sites in their editorial information for authors. In this it may have been that the researcher was seeking further information to inform decision-making, for example, '*I learned mostly from reading journals*' OA *policies at their Websites*' (RG185) or that they were offered the option to publish open access in subsequent communications, e.g., '*The option for open access when I submitted a paper, requesting yes/no answer. That made me think about it and discuss with my supervisors if we had money to pick this option*' (RG37). While information from publishers was freely available on their Websites (including a blog from '*one of the academic publishing conglomerates*' (RG235)) some found this information unclear: '*Different journals also have different parameters when it comes to* OA *publication and sometimes it's very confusing*' (NA206) and '*When I've had to fill out the forms on a journal's Website, I get some sense, but it's a lot of legal language, so I mostly skip it*' (S361), and there was still some scepticism about the information and who would actually benefit:

> *Simply reading the journal's page on submission fees. This is the only industry that the researchers, intellectual proprietors, and main assets of the industry are asked to pay money for publishing of their research (product), from which parasitic APC journals profit from providing no valuable services whatsoever.* (NA151)

Several respondents also identified themselves as editors of journals that offer open access (e.g., S36, S54, S55, S99, S212, RG342, PG399), with some adding that they had to learn about open access once they took on the role (S99, PG399).

Other key open access information sources expanded on by participants in free text responses included colleagues, funding bodies, external organisations, informal training, and online resources. Information through colleagues encompassed formal and informal discussions. Often this was in relation to co-authored papers where one author had more

experience with open access, mentors, and networking at conferences. Interestingly one respondent indicated that junior colleagues were informative, suggesting that careers in industry after the PhD were a primary driver in their decisions to publish open access (CS157).

Information from funding bodies primarily related to their requirements for funding where they have mandatory open access publishing attached to awards (e.g., S61, Y111, RG116). Despite this stipulation, funders did not always then allow researchers to use awarded funds to support open access publishing: '*Open access only possible if funders support it, but many still do not particularly support those fees*' (S379).

As a source of information, external organisations covered a broad range, such as country-based organisations (Norwegian Centre for Research Data; France's National Centre for Scientific Research; Open Science Fellow Program by Wikimedia Germany; Open Access India); a discipline-based Council of Editors for Open Access; and many others (e.g., JISC, Plan-S, UKRI, Coalition-S, AERA, OAJ, BOAB, Project Gutenberg, OAJIS, Creative commons sources; Sherpa Romeo; and Open Science).

Responsibility of institutions

We asked the respondents about their (dis)agreements with statements relating to the responsibilities that institutions should have in relation to open access training. Table 15 presents the result. The mean value for all statements indicates that, overall, respondents were slightly in agreement with values being just above 3. Doctoral students tended to agree with all four statements more than the other three groups did. The agreement also increases as we move from statements about requirement (that training becomes mandatory for students (M = 3.30), and that supervisors train doctoral students (M = 3.43),) to statements about provision of optional training (M = 3.88) and resources for students (M = 4.05).

Doctoral education	Current doctoral student	Awarded a doctoral degree in 2015 or later	Awarded a doctoral degree in 2014 or earlier	No doctoral degree and not studying for one	All respondents
Institutions should require doctoral students to undertake mandatory open access training	3.45	3.44	3.17	3.34	3.30
Institutions should require supervisors to train doctoral students in open access	3.71	3.58	3.25	3.58	3.43
Institutions should provide optional training in open access specifically for doctoral students.	4.10	4.00	3.73	3.90	3.88
Institutions should provide resources (Web pages etc.) about open access specifically for doctoral students	4.30	4.14	3.93	4.00	4.05

Table 15. To what extent do you agree or disagree with the statements (Mean values; 1 = strongly disagree to 5 = strongly agree) (*n* = 1,456)

Free-text comments

How training might be delivered, who should be receiving training, and whether training should be mandatory were all themes in the responses provided to the final open question. There were also many suggestions that any training should expand to encompass all aspects of publishing for doctoral students from outlining a programme of publishing, to choosing suitable journals and conferences.

While there was strong support for training doctoral students in open access, this looked quite different for many respondents. Although concrete avenues were offered, such as via online resources, library staff (RG34, CS228, S392), through graduate schools (RG174, RG252), or formal coursework, more respondents suggested that *ad hoc* learning through discovery on an as-needs basis was a suitable way of learning about open access. Websites both within institutions and broadly available were recommended, suggesting that there is already '*lots of excellent information online*' (S88) and this should be referred to and respected by institutions, rather than replicating this in-house: '*Having pointers to the best already-available information would be much more efficient*' (S88).

When considering training for doctoral candidates, views varied widely on the complexity of open access, from '*it's very confusing*' (NA206) and '*It's a complex system*' (NA373) to '*but seriously it's not a complicated thing to learn*' (PG421) or '*OA seems straightforward*' (S418). Some claimed training in open access was '*crucial*' (RG13) and important for student success (RG86, RG266, RG321), where others minimised its importance: '*Honestly, I don't feel like open access training is all that critical*' (RG274). Those who were not in favour of training were concerned with a further imposition on students' time (S39, CS317, CS334), while some just stated it was not necessary without further expansion (e.g., RG141, S350, PG397). However, reasons given against training were primarily that there was sufficient information already available, or that providing training would be supporting the unethical model that many participants believed author processing charge-funded open access to be. This was typically linked to respondents' attitudes to open access as inaccessible due to exorbitant costs, as summarised by one respondent: '*I do not think this training is important. Open access is easy to understand. The primary barrier to open access is cost*' (PG79). Further, detractors suggested that '*formal training would be a gross exaggeration of its [open access] importance*' (S184), and '*Open Access is not a very complex concept. The idea of 'training' in OA seems a bit [of] overkill*' (RG183).

In contrast, many respondents felt that open access training *was* necessary, but not just for doctoral students. There were suggestions that training in open access should begin at undergraduate level, or at least at Honours or Master's level when research is initially undertaken and often published (RG143, PG162, RG218, PG404). Others called for across-the-board training for both doctoral students, supervisors, and more experienced researchers who may need to '*catch up*' to their new, often younger, colleagues (RG264), as described by one respondent: '*At my institution, it is the doctoral students and junior researchers that have been pushing towards more open access*' (S15).

The role of the supervisor also drew a diverse response. A number suggested that supervisors would not be an appropriate source of training because they may themselves not have the training or knowledge of open access to support their students (RG34, S57, CS317), which was admitted to by one former senior academic responsible for doctoral students: '*I'm a bit embarrassed not to know more about open access policies and trainings for PhD students*' (S236). Others suggested that a supervisor's in-depth disciplinary knowledge (S258, S414) and the responsibility to support students to publish in high-quality journals inherent to their role as supervisor (S26, CS385, S410) were factors. In fact, training their students in open access was fundamental to the supervisory process. In this it was suggested that, as those with the most publishing experience, supervisors are the mentors who model best practice in guiding

candidates towards suitable publication opportunities (S121).

Some respondents shifted the responsibility to the organisation, proposing either formal doctoral training that is delivered by graduate schools or librarians, or by more collegial, informal means. Further, training need not be the remit of any one group: it has been suggested that training could be available, then supplemented with discipline-based information from the supervisory team (CS50, S258, RG364). Importantly, a component for many respondents in considering training in open access for doctoral students was whether any training provided should be mandatory or optional. Some claimed it was already part of their institution's system (S290) or should just be another element in the '*existing professionalization*' of students (CS334), and therefore should always be optional. While it was noted that knowledge of open access was necessary, respondents to the open-ended questions were overwhelmingly against making open access training mandatory. Again, the debate about mandatory training was linked back to the often-prohibitive costs (RG168, S391).

For some respondents, training in open access publishing was closely aligned with ethics training: '*If open access training is considered relevant for research practice and knowledge utilization, it should be mandatory, as is ethics training*' (RG314). One respondent even suggested an outline for the module: '*Training should include discussions about: (1) Financial model of publishers (2) Ethical and moral arguments for/against knowledge as a public good (3) Open access vs reproduceable research*' (NA400), leaning into the social justice ethos that sits behind open access publishing (Batterbury, 2017; 2020). Others expanded open access training into a broader unit encompassing all aspects of publishing, from devising a publishing or conference plan that underpins a researcher's professional identity, through journal selection with a focus on research impact and securing tenure, to how to fund publications that align with these goals (RG167, S223). In this context, the issue of distinguishing quality journals from predatory and exploitative publishers was also raised (NA151, S269, S292).

Barriers and facilitators to open access training

Even within the debate around the concept of training in open access for doctoral students, there was an undercurrent of frustration, irritation, and pessimism from respondents. The issue of high publishing costs was paramount, and a sense of futility was evident: why train in open access if we cannot afford to publish open access?

Pessimism was expressed in both value terms (was it actually achieving its goals of social justice?) and in terms of its relevance, which was often tied to the discipline and the audience: '*readers of my papers all have institutional access to the papers that I publish*' (RG119). In terms of social justice, respondents suggested institutes and universities in developing countries, researchers with limited resources (for example early career researchers and doctoral students), and in disciplines where funding is limited should have lower, or no, fees to publish open access (S10, S60, CS251). Fees were described as '*exorbitant*' (S402), '*unethical*' (S77), '*extraordinary*' (CS40), '*astronomical*' (NA343), '*a waste of money*' (PG53, RG260), and unaffordable (RG274, S280, RG346) ,and the system as '*questionable*' (S244), '*fundamentally flawed*' (RG141), '*shady*' (RG331), a '*rip-off*' (S322), and '*a scam*' (S81). There was also considerable suspicion about the motives behind the cost of open access which many researchers did not want to be party to: '*OA is the biggest scam launched by rich journals and supported by developed nations*' (S367).

In terms of motivations for publishing in open access journals, university policy that required researchers to publish open access was a factor, as was fulfilling funder requirements, and striving to improve a researcher's Productivity Index. However, university agreements with publishers that allowed more open sharing of research for low or no cost were a key component to enabling open access publishing for many.

Respondents also suggested structural change was needed, rather than additional training: '*Don't just train students - change the system!!*' (NA49). In this they sought to redress the inequalities of the high cost of publishing open access, by calling for systemic change from both publishers and universities. One respondent cited an open access fee that was more than the entire cost of the research (CS163); another noted that publishing open access is more than their monthly salary and they '*would rather pay human beings to help with research than pay to publish Open Access for one researcher*' (RG124). Another respondent summed it up: '*it is not about training, it is about money*' (CS195).

One additional finding from the analysis of free text responses is worth noting. As can be easily deduced from the preceding paragraphs, respondents almost always chose to focus their commentary on issues related to Gold models of open access. The terms *funding* (n=50), *cost* (n=33), APC (n=25) and *money* (n=23) all appeared relatively frequently in answers. In contrast, discussions of Green options for open access were almost entirely lacking. The term *repository*, for example, appeared in only three responses. While the questionnaire did not specifically interrogate perspectives on different models of open access this secondary finding suggests that for many respondents, to publish open access means to pay for publication.

Discussion

In discussing the findings reported above we return to the research questions that guided this study.

RQ1. What forms of training in open access have current and recent doctoral students received as part of their doctoral studies?

The survey results indicate that a large majority of current (81%) and recent (84%) doctoral students are or were not required to undertake mandatory open access training. Responses from doctoral supervisors aligned with this, with 66% stating that there was no mandatory training for doctoral students at their institution. The *Don't know* figure was slightly higher for supervisors (16%), suggesting some uncertainty about what is required of doctoral students. This finding supports earlier findings in the literature suggesting that open access training is often not considered an integral part of doctoral student training (Schöpfel et al., 2019; Panchenko et al., 2021). Mandatory training was found most likely to be delivered via presentations or workshops and/or through the provision of online resources, and respondents consistently indicated that mandatory training was primarily provided within the school, department, or faculty. This is significant, as it might suggest that the requirement to undertake such training is imposed at that departmental or faculty level; were it a university-level policy, we might expect the delivery of the training to be centralised. That said, the presence of mandatory training was more or less consistent across subject areas. Our findings provide little evidence that certain disciplinary areas are more likely than others to have identified a need for graduating doctoral students to have been trained in open access.

As might be expected, optional open access training was found to be more prevalent, with just over one-third of respondents indicating that this optional training was available during their degree, or at their institutions. This figure, however, feels surprisingly low given the increasing focus on open scholarship practices in higher education. It seems possible that our findings here require some interpretation, and that they might be better said to reflect awareness of institutional open access training among respondents. The high likelihood of responsibility for open access training being allocated to libraries is an important finding, given that earlier studies have argued that librarians may themselves need more comprehensive training in open access in order to effectively deliver such tuition to others (Cole and Evans, 2014; Rodriguez, 2015).

RQ2. To what extent has open access training informed respondents' understanding of open access, and influenced publishing practices?

We can compare general findings related to respondents' understanding of open access and importance of open access in publishing decisions, and the same data specifically for

respondents who stated they had undertaken training. Overall, 54% of respondents stated that their understanding of open access was good or excellent, with those awarded their doctoral degree more than 10 years ago (59%) more likely to highly rate their understanding than current (39%) or recent (51%) doctoral students. This is perhaps to be expected, as understanding of the complexities of open access is likely to develop as researchers spend time writing and publishing articles. It is an interesting anomaly, however, that those awarded a doctoral degree in 2014 or earlier actually had a lower mean understanding score (3.25) than more recent doctoral students, suggesting a significant number of more experienced researchers rated their understanding poorly. This could be indicative of a greater appreciation of the complexities of open access. In terms of our research question, though, there was a statistically significant difference in levels of understanding of open access, with those who have completed some form of open access training rating their understanding more highly than those who have not undertaken training. This confirms arguments made elsewhere in the literature that highlight the importance of adequately training doctoral students in open access (Carroll et al., 2017).

The importance to respondents of open access as a factor in selecting a journal for publishing their most recent article were found to be broadly in line with many other studies on publication choice, suggesting that open access is an important but far from overriding concern. Again, however, a statistically significant difference was observed between respondents who have completed training and those who have not. These findings provide some solid evidence that open access training has an impact on researcher knowledge and practices, and support the similar finding by Read et al. (2022).

RQ3. What sources of information, other than formal training, inform authors' understandings of open access?

Given the low numbers of respondents who reported undertaking mandatory or optional open access training, it is instructive to consider where else researchers are obtaining their knowledge of open access principles and practices. Web resources and colleagues were found to be the most highly rated sources, but publisher information also scored highly, which may be cause for some concern. While it is evident that publisher information about open access may be of value to researchers, if for no other reason than to explain the specific open access options available to authors submitting to a particular journal, publishers are naturally incentivised to describe positively the forms of open access they offer to authors, and therefore can hardly be said to represent an objective source of information about open access in general terms. Figures relating to doctoral supervisors were also perhaps surprisingly low; the traditional student-supervisor model typically suggests that as well as directing the student's research, the supervisor also plays a key role in developing their understanding of academia in general. Our data suggests that, in broad terms, supervisors are not significantly informing early career researchers' understandings of open access.

RQ4. To what extent do researchers believe there is a need for increased formal training in open access?

Two clear pieces of evidence emerged from the quantitative analysis of survey responses to address our final research question. First, only 27% of respondents answered that the level of open access training offered as part of their doctoral studies was sufficient. Second, there was widespread agreement with a number of statements presented to respondents that related to actions institutions could take to support researcher understanding of open access. There was widest agreement with the notion that institutions should provide Web resources about open access specifically for doctoral students, followed by optional training for these students. The statement that suggested institutions should require doctoral students to undertake open access training received agreement or strong agreement from almost half of respondents (45%).

The qualitative data from the free text responses, however, revealed a more nuanced

picture. We found quite distinct differences in individual perspectives on open access, both in terms of its complexity and the need for doctoral training specifically related to open access. Those who supported the notion of mandatory open access training disagreed about who should deliver it and what it should cover, while those opposed to the idea of training did so for a variety of reasons. The diversity of opinions expressed in the free text comments neatly encapsulate the challenges faced by those attempting to increase open access performance; opposition to open access is clearly strong in some quarters, but the range of justifications for that opposition defy any single simple counterargument.

Conclusion

This study has shown that mandatory training in open access is or was a requirement for only 14% of the 1,569 respondents to our survey, with only 27% of respondents believing that the current provision of open access training for doctoral students is sufficient. Findings also suggest that researchers who have undertaken training in open access report a better level of understanding of open access and place more importance on open access as a factor in selecting a journal. Only around a third of respondents indicated that optional training in open access was available at their institution, a surprisingly low figure given the increasing focus on open access at many institutions. We suggest that our findings here may reflect low levels of awareness of optional training and resources related to open access.

There appears to be widespread support for institutions to develop further training in open access, although the issue appears to be polarising, with a significant number of respondents deeming it unnecessary. Free-text responses to open questions focused almost exclusively on Gold OA in general, and author processing charges (APC) models in particular, suggesting that awareness of Green OA options remains poor, and that for many researchers open access publishing is synonymous with the payment of fees.

The study has some limitations. While the total number of responses was sufficient to draw meaningful conclusions from the data, response rates to survey invitations were low. This could suggest a lack of engagement with or understanding of open access (although it might also be a symptom of a more general survey fatigue). The complexity of open access itself, combined with the need for respondents to self-assess their levels of understanding of open access, may have led to some variation in how some questions were interpreted by respondents.

In the future we intend to conduct research that focuses on the aspects of open access that training could and should cover and investigate the models of training delivery that institutions could most usefully employ to better train doctoral students in this complex space.

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