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Scholarly Publications: Criteria, Types, and Recognition From the Researchers' Perspective

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ABSTRACT

Based on a survey, this study investigates the perceptions of researchers in Austria concerning scholarly publications, exploring criteria, types, and emerging types of publication and their future recognition. The findings reveal that researchers value a diverse set of criteria, with content-related factors prioritised over formal ones. While traditional publication types remain dominant, novel forms, such as data publications and replication studies, are gaining recognition. Researchers ($n = 616$) express a desire for broader recognition of diverse types of work, particularly data publications, teaching materials, and software or code. The findings also exhibit the predominantly research-to-research focus of scholarly communication, with limited emphasis on science-to-public engagement. An analysis of career stages shows that pre-doctoral and post-doctoral researchers tend to be more open-minded than professors regarding the future recognition of some novel types of publication. There are evident differences between disciplines, highlighting the need for a nuanced, subject-specific approach to evaluation and documentation. Overall, the survey results call for greater consideration of novel publication types in research assessment and documentation. Accordingly, libraries should enhance their research support services to assist in the publication, documentation, and archiving of additional types of publication.

1 | Introduction

Scholarly publications are a crucial factor in various approaches to determining academic excellence, for example, for university rankings, funding allocations, and faculty appointments. The concept of 'scholarly publications', however, has evolved significantly over the years. Traditional formats, such as journal articles, conference papers, and monographs, are complemented by new formats, including scholarly blogs, data publications, and software and code publications. This evolution is reflected in concepts such as 'non-traditional research output' (NTRO) used in Australia (ARC) and the UK (HEFCE/REF)[1], and also in the expanding range of publication types indexed by scholarly literature databases. The Web of Science Core Collection, for example, now contains publication types such as *data paper*, *editorial material* and *correction* as well as various review types

(*book review*, *database review*, *film review*, *hardware review*, *music performance review*, *record review*, *software review*, *theatre review*) (Clarivate 2023), while Scopus includes *conference review*, *editorial*, *erratum*, *review* and *short survey*, among others (Elsevier 2023). ORCID[2] provides a list of types of work that includes *encyclopaedia-entry*, *newspaper-article*, *review*, *website*, *annotation* and *data-set* (Blackburn 2022). The Coalition for Advancing Research Assessment (CoARA) mentions 'scientific publications, data, software, models, methods, theories, algorithms, protocols, workflows, exhibitions, strategies, policy contributions, etc.' as well as 'replication studies, registered reports, [and] pre-prints' as types of research output to be considered in evaluation (CoARA 2022, 4).

These heterogeneous typologies highlight the need for clear definitions and a comprehensive framework of publication types that

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Summary

- Generally, researchers prioritise content-related criteria over formal criteria.

- Traditional publication types, such as journal articles, remain the most widely recognised among researchers, while novel types are gaining recognition.

- In the future, according to researchers, research data publications, replication studies, software/code publications, and teaching materials should receive greater recognition as scholarly publications.

- Pre-docs and post-docs are more open to the recognition of novel types than professors.

- A more nuanced, discipline-specific approach to research assessment and documentation is needed.

goes beyond traditional formats and takes into account the diverse forms of research output that should be considered scholarly publications. To date, however, there is no consensus on the exact criteria that constitute a scholarly publication, defining how it is distinct from the broader term 'scholarly output', nor is there a single, generally applicable catalogue of publication types.

Nevertheless, the questions of which types of work are recognised as scholarly publications and what criteria they should meet have profound implications for academic institutions, funding bodies, and research libraries. Key areas affected include:

- Documentation of research outputs: Which types of work should be documented in Current Research Information Systems (CRIS)?

- Research evaluation: Which types of work should be relevant for researchers' career development and research funding?

- Publication funding: For which types of research output could an institution or a funding body be expected to pay publication costs?

- Research support services: For which types of publication might researchers need assistance from their institutions?

- Collection development and preservation: Which types of work are considered relevant enough to be collected and curated for long-term preservation?

In addition, the definition of what constitutes a scholarly publication has major implications for researchers. Key aspects include:

- Relevance and reliability: Which forms of output are considered relevant enough to be cited and built upon? Who decides on this question, and according to what criteria?

- Career development and research funding: Which forms of publication and research output are recognised by the respective scientific community as well as by research evaluation and funding bodies and are thus taken into account in decisions on funding and promotion?

1.1 | Definitions of 'Scholarly Publications' and the Emergence of Non-Traditional Research Outputs

Scholarly publications are generally regarded as a subset of scholarly output (results of academic research) or research performance. Different definitions and categorisations can be found in policy papers, research assessment guidelines, and databases. However, definitions of what exactly is (or is not) to be considered a scholarly publication are scarce and tend to be rather unspecific. Empirical studies on this topic are rare.

Traditionally, definitions of scholarly publications have emphasised quality assurance through peer review, the citation of relevant literature, and the dissemination of new research results. Simon (2021) adds that scholarly publications should serve as comprehensive records of scientific discoveries that impact both the research community and society as a whole.

It is striking, though, that while certain characteristics or criteria have been defined as essential for scholarly publications, there are few empirical investigations into the relative importance of these criteria within the research community and across disciplines. The few include studies conducted by Chase (1970); Halliday (2001) and Dougherty (2018).

Chase (1970) identified 10 criteria for scholarly publications, including originality, logical rigour, relevance in the discipline, and replicability of research techniques. She conducted a study among nearly 200 natural and social scientists, asking them to rate each criterion in relation to their discipline. While both groups prioritised logical rigour and reproducibility, different patterns emerged, highlighting the need for discipline-specific considerations in defining scholarly output.

Halliday (2001) further elaborated on this by proposing a framework of 22 essential or desirable criteria. The framework focused on formal rather than content-related criteria to determine what constitutes a scholarly publication, among them the publication's accessibility, durability, trustworthiness (based on 'institutionalised' measures such as peer review), and commitment not to withdraw the publication. Based on this framework, Halliday conducted a study among a select group of eight library and publisher representatives who were asked to rank these criteria as 'essential', 'highly desirable' or 'preferable'. Highly desirable characteristics were that 'the publication should not be changed', 'the publication should have stable identifiers', 'different versions should be clearly identified', 'trustworthiness should be based on 'institutionalised' measures such as peer review rather than on personal knowledge', and 'the potential audience must be made aware that the publication exists'.

Dougherty (2018) outlined six requirements for scholarly publications, emphasising identifiable authorship, academic publisher involvement, and cataloguing in university libraries and curated research databases. Furthermore, they should 'putatively advance or summarise knowledge' and 'belong to at least one recognised academic discipline' (Dougherty 2018, 20).

In recent years, there has been growing acknowledgement of 'non-traditional research outputs' (NTROs). According to the

Excellence in Research for Australia (ERA) guidelines, NTROs include original creative works, digital artefacts, live performances, and public exhibitions, which are increasingly recognised as legitimate scholarly outputs (ERA 2023). Research by McKee (2020) identified 19 criteria for assessing the academic quality of NTROs, emphasising the importance of context and the creator's engagement with the academic community. Williams (2023) further discusses the evolving landscape of research outputs in creative fields, advocating for the recognition of diverse publication formats as legitimate contributions to knowledge, while also emphasising the need for accompanying statements that articulate their significance and impact. Alperin et al. (2022) highlight the growing acknowledgement of diverse forms of scholarship, such as data management and sharing, particularly in fields like the social sciences and humanities. While a study by Hurrell and Hall (2023) also emphasises that NTROs are increasingly acknowledged, it shows, too, that they often struggle for recognition in tenure and promotion processes, indicating a gap between evolving practices and traditional evaluation criteria. Hurrell (2023) found that while 96% of the reviewed repositories contained various types of NTROs, these outputs often made up a small proportion compared to traditional outputs, like peer-reviewed journal articles.

In summary, these findings show that the definitions of 'research outputs' and 'scholarly publications' are undergoing significant transformations, reflecting the diverse ways in which research is communicated and valued. They also highlight the complexity involved in defining criteria and requirements, as well as in evaluating NTROs, since their significance and recognition may vary across disciplines and contexts. While traditional formats continue to hold sway, the emergence of NTROs necessitates a broader understanding of scholarly output, encompassing a variety of formats, an ongoing dialogue within academic institutions, ensuring that all forms of scholarly communication are recognised and valued appropriately, and greater awareness and promotion of NTROs within academic institutions.

As the Coalition for Advancing Research Assessment (CoARA) advocates, a more inclusive approach to evaluating scholarly output is essential to maximise the quality and impact of research (CoARA 2022).

1.2 | Situation in Austria and Background to the Study

In 2015, the Open Access Network Austria (OANA) recommended that by 2025, all publicly funded scholarly publications should be published in Open Access (Bauer et al. 2015). Monitoring this objective requires a precise definition of what should and should not be counted as a scholarly publication, ideally taking into account the differences between disciplines.

The Austrian Intellectual Capital Report ('Wissensbilanz'), a performance measurement tool for Austrian universities, uses a very limited classification of scholarly publications. It includes first editions of specialist books or textbooks (including edited volumes and conference proceedings), scholarly journals and anthologies, original articles in scholarly journals and anthologies (including articles in conference proceedings), artistic audio, visual and data media and contributions to these, art catalogues and other artistic printed works and contributions to these. All other forms of publication, regardless of the medium, are collected under 'other scholarly/artistic publications' (Bundesministerium für Bildung, Wissenschaft und Forschung 2023, 107–109). Given the proliferation of new publication formats, it seems useful to examine what researchers define as a scholarly publication in order to identify emerging categories that deserve separate reporting in the future.

The considerations outlined above were the initial motivation for the survey we conducted among researchers from various disciplines in Austria in the spring and summer of 2023, asking them to identify the criteria and types of scholarly publication they consider relevant now and for the future. The results indicate which types of publication are recognised across disciplines and career stages, which criteria are considered relevant for classifying a publication as scholarly, and which publication formats researchers would like to see given more recognition in the future.

Our results could contribute to a more comprehensive definition of 'scholarly publications', help map the current landscape and terminology, and be used to inform research documentation, research evaluation, library collection development, publication funding, and research support.

2 | Methods

2.1 | Survey

Our online survey was set up in LimeSurvey (Version 3). It consisted of six blocks of questions and was based on the results of a pre-study[3]. Information from the pre-study, as well as from an additional round of feedback, was used to refine the questions and response options and improve the main study. The blocks of the survey represented the following categories: criteria, authors, target groups, types, deciding factors, and future types of scholarly publication[4].

This article focuses on the results concerning criteria, types and future types of scholarly publication. The other aspects are discussed only briefly.

2.2 | Sample and Statistical Power

The survey was distributed to academic staff at all Austrian universities with the support of university libraries and administrative departments between June and August 2023. A total of 1125 people clicked on the link to the survey. After excluding incomplete cases, the final sample was $n = 616$.

We collected detailed information on the scientific disciplines. For our analysis, we grouped participants according to the main academic fields in Austria (Statistik Austria 2012). Those were the natural sciences ($n = 213$; 35%), technical sciences ($n = 97$; 16%), human medicine and health sciences ($n = 76$; 12%), agricultural sciences and veterinary medicine

($n = 14$; 2%), social sciences ($n = 119$; 19%), and humanities ($n = 97$; 16%). Due to the very small number of participants from the agricultural field, we excluded this group from the confirmatory analyses to avoid an overly biased interpretation. Notably, as we could not use the same channels to communicate the survey at all universities, the participants were distributed unevenly across the disciplines. Participants from the natural sciences and humanities are overrepresented in our survey sample, whereas the technical sciences and medicine are underrepresented[5]. This may have had an impact on the results of the analyses across all participants.

The largest group of participants was aged between 30 and 39 years (27%), followed by those aged 40–49 years (22%) and 50–59 years (21%). There were 133 (22%) doctoral students, 209 (34%) post-docs, and 246 (40%) assistant, associate, or full professors. Twenty-eight participants (4%) identified their career status as 'other'; these were excluded from the corresponding analyses. We did not collect data on the gender of participants.

After data collection, we performed a power sensitivity analysis to see which effects we could reliably find and interpret in our confirmatory analysis. With the statistical power of 90% and a 5% type I error probability, we were able to detect a standardised effect (measured in Cohen's d metric) of 0.26 between participants in the survey.

2.3 | Analysis Strategy and Hypotheses

We analysed the scores descriptively for all the options in a similar way. As 'criteria' and 'types' were measured on five-point rating scales, we calculated the mean rating across participants and evaluated its location on the scale. (See the Supporting Information[6] for additional descriptive and inferential information.) For current 'types' of scholarly publication, we excluded data from participants who indicated that certain types do not occur in their fields, as this would distort the analysis of variance (ANOVA), which relies on the mean values. As 'future types' did not contain a rating scale, we counted the approval ratings across all participants (i.e., whether participants indicated that a type of scholarly publication should become more recognised in the future) and analysed them through Chi^2 analyses. In this way, we sorted all the options according to the participants' ratings. We also split the options according to the participants' disciplines to get a more nuanced picture of these ratings. However, we only carried out analyses by discipline or career status if statistical tests for group differences yielded p values smaller than 0.001 to reduce the risk of reporting false-positive findings.

In line with our preregistration[7], we hypothesised that (H1) researchers from the natural sciences (compared to other fields) and (H2) academically younger researchers would be more open to considering new publication formats as scholarly publications. These new publication formats were defined as follows: preprints, research data/data sets/data publications, databases/repositories, software/code publications, replication studies, peer review reports, teaching materials/tutorials/Open Educational Resources (OER), and scholarly blog/vlog posts. We tested these hypotheses using an ANOVA and logistic regression for group comparisons. For results, see Section 3.5 confirmatory hypothesis tests.

3 | Results

This paper focuses on key findings related to criteria for scholarly publications, types of publication, and better recognition for certain publication types in the future (Sections 3.1–3.3). Questions concerning authorship, target groups, and deciding factors are discussed more briefly (see Section 3.4). Data analysis and visualisation were performed using Jamovi (Version 2.5) and Excel (2021). Complete results are available in the Supporting Information[8].

3.1 | Criteria for Classifying a Work as a Scholarly Publication

As illustrated in Figure 1, the participants strongly agreed with most of the proposed criteria for classifying a work as a scholarly publication. Notably, none of the proposed criteria were rated 'not at all important' or 'rather not important'. Content-related criteria generally took precedence over formal aspects such as *publication date stated*, *persistent identifier*, and *careful linguistic and formal presentation*. Discipline-specific differences occurred for only a few criteria, such as *based on scientific data*, *results are replicable* and *quality assurance through peer review*. Obviously, criteria such as replicability are only relevant for a specific subset of publication types and subjects that rely on empirical methods.

Of all the criteria, *transparent and comprehensible methodology* received the highest mean score ($M = 4.85$) and was thus rated most important by our survey participants. The criteria *adherence to standards of good scientific practice*, *identifiable authors*, *comprehensible argumentation*, *permanent availability of the publication*, and *objectivity* were also rated well above $M = 4.50$. In addition, *citation of sources*, *scientific terminology and precise use of language*, *results based on scientific data* and *answering research questions* were also rated highly, with average scores around $M = 4.50$.

Most of the formal criteria, such as *publication date stated*, *persistent identifier*, and *careful linguistic and formal presentation*, were generally considered less important by the respondents. The criteria *review by editors*, *review by publishing editors* ($M = 3.04$), and *aimed at readers with prior knowledge of the subject* ($M = 2.98$) were identified as the least important.

Interestingly, respondents indicated that it is not a top priority that scholarly publications *contribute to the current state of research* (ranked 13th out of 25 criteria), though other studies (Dhillon et al. 2015) have mentioned the novelty of the results as one of the most important criteria. Similarly, *peer review* does not rank particularly highly among the proposed criteria (15th out of 25), although it has often been referred to as a defining feature of scholarly literature (Sucato and Holland-Hall 2018).
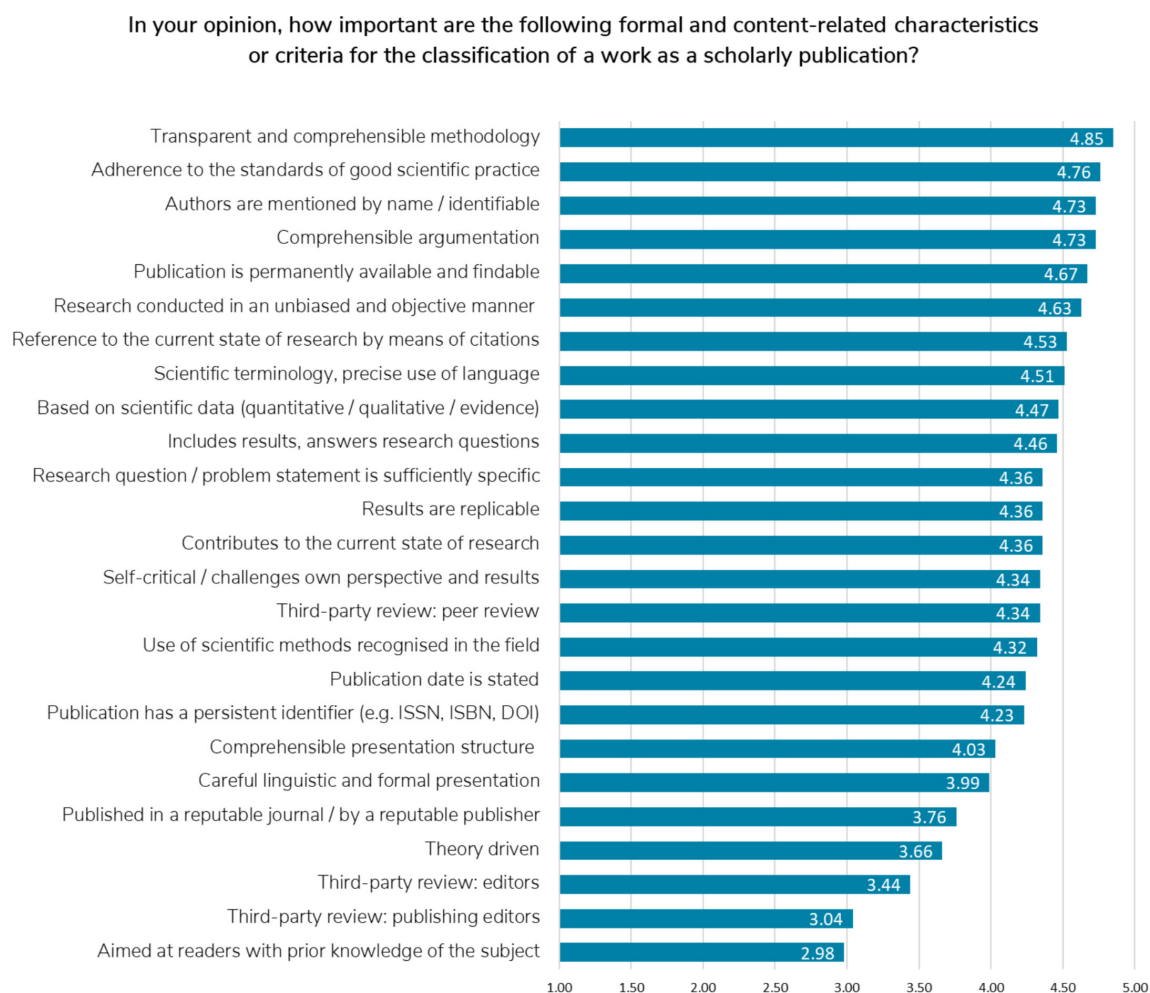
In your opinion, how important are the following formal and content-related characteristics or criteria for the classification of a work as a scholarly publication?

Transparent and comprehensible methodology	4.85
Adherence to the standards of good scientific practice	4.76
Authors are mentioned by name / identifiable	4.73
Comprehensible argumentation	4.73
Publication is permanently available and findable	4.67
Research conducted in an unbiased and objective manner	4.63
Reference to the current state of research by means of citations	4.53
Scientific terminology, precise use of language	4.51
Based on scientific data (quantitative / qualitative / evidence)	4.47
Includes results, answers research questions	4.46
Research question / problem statement is sufficiently specific	4.36
Results are replicable	4.36
Contributes to the current state of research	4.36
Self-critical / challenges own perspective and results	4.34
Third-party review: peer review	4.34
Use of scientific methods recognised in the field	4.32
Publication date is stated	4.24
Publication has a persistent identifier (e.g. ISSN, ISBN, DOI)	4.23
Comprehensible presentation structure	4.03
Careful linguistic and formal presentation	3.99
Published in a reputable journal / by a reputable publisher	3.76
Theory driven	3.66
Third-party review: editors	3.44
Third-party review: publishing editors	3.04
Aimed at readers with prior knowledge of the subject	2.98

FIGURE 1 | Most important criteria for classifying a work as a scholarly publication (all participants; 1 = 'not important', 5 = 'very important'; n = 609–616).

In your opinion, how important are the following formal and content-related characteristics or criteria for the classification of a work as a scholarly publication?
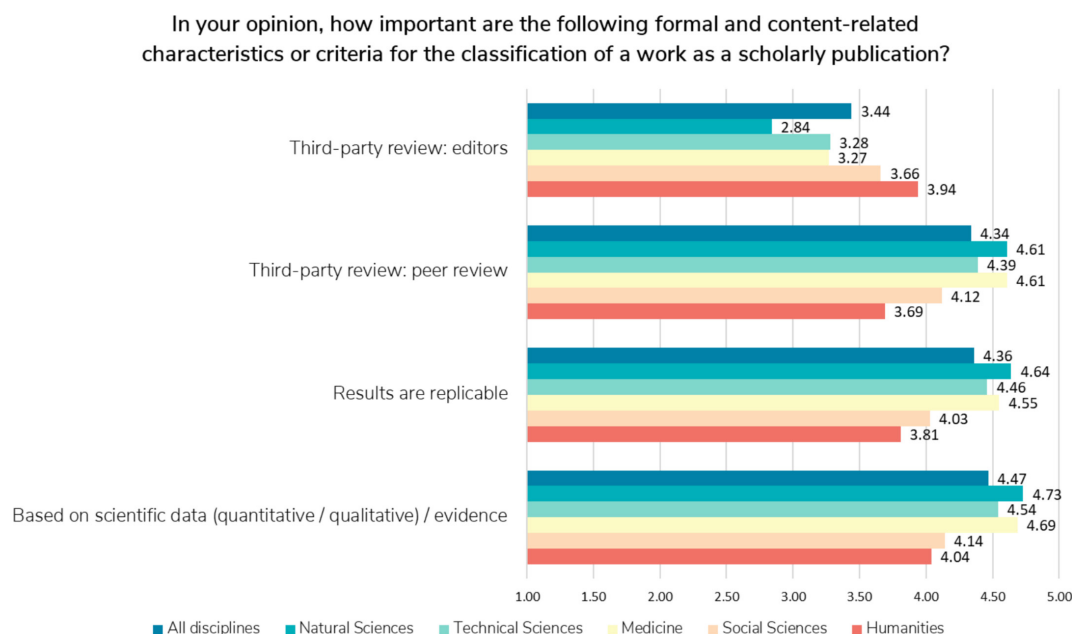

FIGURE 2 | Selected criteria for classifying a work as a scholarly publication (by discipline, main disciplines only; 1 = 'not important', 5 = 'very important').

3.1.1 | Results by Main Discipline

Figure 2 illustrates the differences between the main disciplines in evaluating specific criteria.

In the natural sciences, technical sciences, and medicine, ratings for *based on scientific data, replicable results*, and *peer review* are above average. Ratings for *editorial review* are below average. In medicine, there is a particular emphasis on quality assurance through review processes. The social sciences and humanities show higher acceptance of *editorial review*, while there is a lower emphasis on *peer review*, especially in the humanities.

3.1.2 | Results by Career Stage

Ratings across various career stages revealed significant differences for certain criteria. Professors rated *scientific use of language*, *sufficiently specific research question*, *published in a reputable journal*, *aimed at readers with prior knowledge*, *identifiable authors*, and *citation of sources* significantly higher than post-docs and pre-docs. Conversely, they viewed *review by the publisher* as significantly less important than the average respondent.

3.2 | Types of Work That Are Considered Scholarly Publications

Participants were provided with a selection of 53 types of work (Figure 3). We deliberately offered a wide range of types of work to choose from, including options that might typically be considered 'scholarly output' rather than scholarly publications. By doing this, we aimed to avoid pre-selecting and restricting the responses to the currently recognised types of publication.

We excluded those participants who answered 'does not occur in my field' from our analysis, as these responses would have distorted the mean value. The results show clear differences regarding which types of work are considered scholarly publications in the various disciplines. Eight types of work scored more than $M = 4.00$ on our scale. They largely correspond to the types of work typically used as core elements of publication databases and research information systems.

'Novel' or innovative publication types received moderate recognition ($M < 3.50$). Types of work for communicating science to the public (science communication) receive little recognition as scholarly publications from researchers.

The most widely recognised scholarly publication type is the article in a scholarly journal ($M = 4.95$), followed by special issues of scholarly journals, dissertations, contributions to scholarly edited volumes, and review articles/literature reviews. Scholarly monographs and edited volumes, particularly well-established types of scholarly publication, are also widely recognised by our survey respondents.

Some 'novel' or innovative publication types also mentioned in the CoARA Agreement (CoARA 2022), replication studies, research data/data sets/data publications, preprints, software/code publications, and databases/repositories, rank in the top half of all proposed types of work but receive only moderate recognition ($M < 3.50$).

Of all the suggested types of work, artistic publications are recognised as a type of scholarly publication the least ($M = 1.73$). More than half of all participants indicated 'no opinion' or 'does not occur in my field' for this type.

Publication types widely used for communicating science to the public (science communication)—such as contributions to/interviews in a newspaper, contributions to an internet encyclopaedia, scholarly blog/vlog posts, scholarly websites, articles in a non-scholarly journal/medium, scholarly podcasts, scholarly videos—are not widely recognised as scholarly publications among researchers.

3.2.1 | Results by Main Discipline

The following differences between the main disciplines reflect different publication cultures (Figure 4): In the natural sciences and medicine, fewer types of work are accepted as scholarly publications than in all other disciplines. Researchers from these disciplines gave particularly low ratings for encyclopaedia entries, book reviews, and scholarly editions across both fields.

In medicine, conference abstracts and meta-analyses received high ratings, while there is little recognition for types of work like scholarly monographs, contributions to a festschrift (liber amicorum) or encyclopaedia/lexicon entries. The technical sciences show greater acceptance of conference posters, slides, master's theses, and dissertations, and less recognition for replication studies, festschrift contributions, and book reviews. In the social sciences and humanities, a wider range of types are recognised as scholarly publications, including legal commentaries, interpretations, book reviews, and festschrift contributions. There is less recognition in these disciplines for conference posters and conference abstracts. The social sciences assigned high, above-average ratings to handbooks, policy papers, replication studies, meta-analyses, working papers, and, in particular, legal commentaries. Conference proceedings and slides are less well recognised. Of all disciplines, the humanities recognise the most types of scholarly publication, including a range of potential science-to-public formats, such as scholarly blog/vlog posts and articles in non-scholarly journals/media. The ratings for articles in scholarly journals and special issues of scholarly journals are consistently high across all disciplines, with only minimal differences.

'Novel' publication types, some of which can also be attributed to Open Science practices, show the following differences between disciplines in terms of recognition: Replication studies receive the most recognition in the social sciences and medicine, and much less in the technical sciences. Interestingly, research data/data publications are better recognised as publication types in the humanities than in the other main disciplines and rank lowest in the social sciences. However, these differences are not statistically significant. Peer review reports receive the most recognition in medicine and the least in the humanities. Software/code publications and preprints receive similar recognition across all disciplines.

Are the following types of works considered scholarly publications in your field?
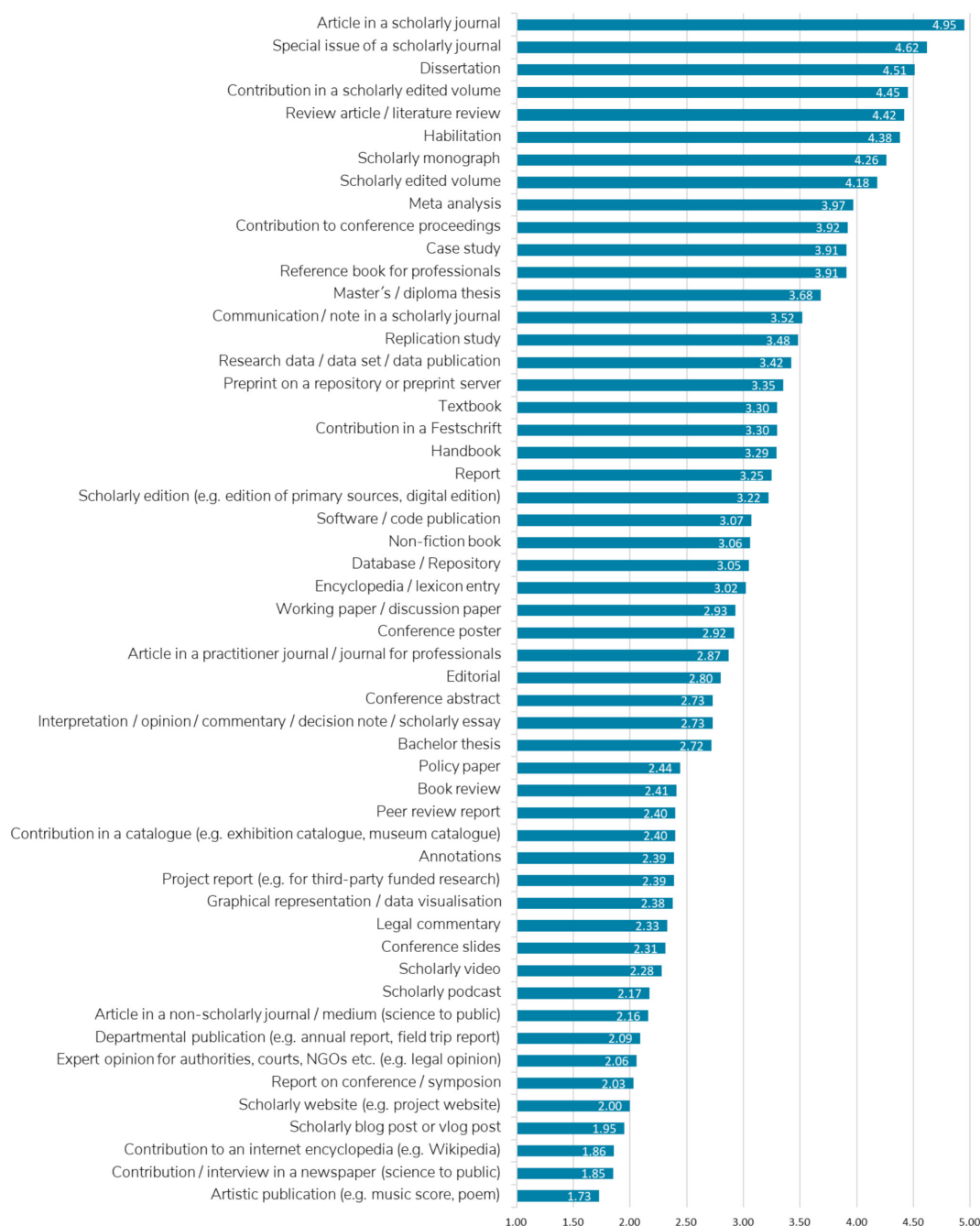

Article in a scholarly journal	4.95
Special issue of a scholarly journal	4.62
Dissertation	4.51
Contribution in a scholarly edited volume	4.45
Review article / literature review	4.42
Habilitation	4.38
Scholarly monograph	4.26
Scholarly edited volume	4.18
Meta analysis	3.97
Contribution to conference proceedings	3.92
Case study	3.91
Reference book for professionals	3.91
Master's / diploma thesis	3.68
Communication / note in a scholarly journal	3.52
Replication study	3.48
Research data / data set / data publication	3.42
Preprint on a repository or preprint server	3.35
Textbook	3.30
Contribution in a Festschrift	3.30
Handbook	3.29
Report	3.25
Scholarly edition (e.g. edition of primary sources, digital edition)	3.22
Software / code publication	3.07
Non-fiction book	3.06
Database / Repository	3.05
Encyclopedia / lexicon entry	3.02
Working paper / discussion paper	2.93
Conference poster	2.92
Article in a practitioner journal / journal for professionals	2.87
Editorial	2.80
Conference abstract	2.73
Interpretation / opinion / commentary / decision note / scholarly essay	2.73
Bachelor thesis	2.72
Policy paper	2.44
Book review	2.41
Peer review report	2.40
Contribution in a catalogue (e.g. exhibition catalogue, museum catalogue)	2.40
Annotations	2.39
Project report (e.g. for third-party funded research)	2.39
Graphical representation / data visualisation	2.38
Legal commentary	2.33
Conference slides	2.31
Scholarly video	2.28
Scholarly podcast	2.17
Article in a non-scholarly journal / medium (science to public)	2.16
Departmental publication (e.g. annual report, field trip report)	2.09
Expert opinion for authorities, courts, NGOs etc. (e.g. legal opinion)	2.06
Report on conference / symposion	2.03
Scholarly website (e.g. project website)	2.00
Scholarly blog post or vlog post	1.95
Contribution to an internet encyclopedia (e.g. Wikipedia)	1.86
Contribution / interview in a newspaper (science to public)	1.85
Artistic publication (e.g. music score, poem)	1.73

FIGURE 3 | Extent to which various types of work are considered scholarly publications (all participants; 1 = 'no', 5 = 'yes'; the response option 'does not occur in my field' is not displayed here).

3.2.2 | Results by Career Stage

Differences in the ratings of various traditional (e.g., scholarly monographs) versus novel types of work (e.g., replication studies) are more pronounced for professors than for post-docs and pre-docs. Professors rate the recognition of well-established publication types like scholarly monographs ($M = 4.50$) and special issues significantly higher than post-docs and pre-docs. Professors give less recognition to novel formats such as replication studies ($M = 3.18$) and peer review reports ($M = 2.21$) than average. The results for research data ($M = 2.92$) and conference posters ($M = 2.72$) are similar but not significant.

3.3 | Types of Scholarly Publications to Be More Recognised in the Future

The responses to the question of which types of work should be recognised as scholarly publications in the future (Figure 5) provide insight into researchers' opinions on how scholarly communication and research assessment should develop.

Analysing the responses about which types of publication should receive more recognition in the future proved to be a complicated task. We offered five response options, three of which referred to a potential change in recognition. Further
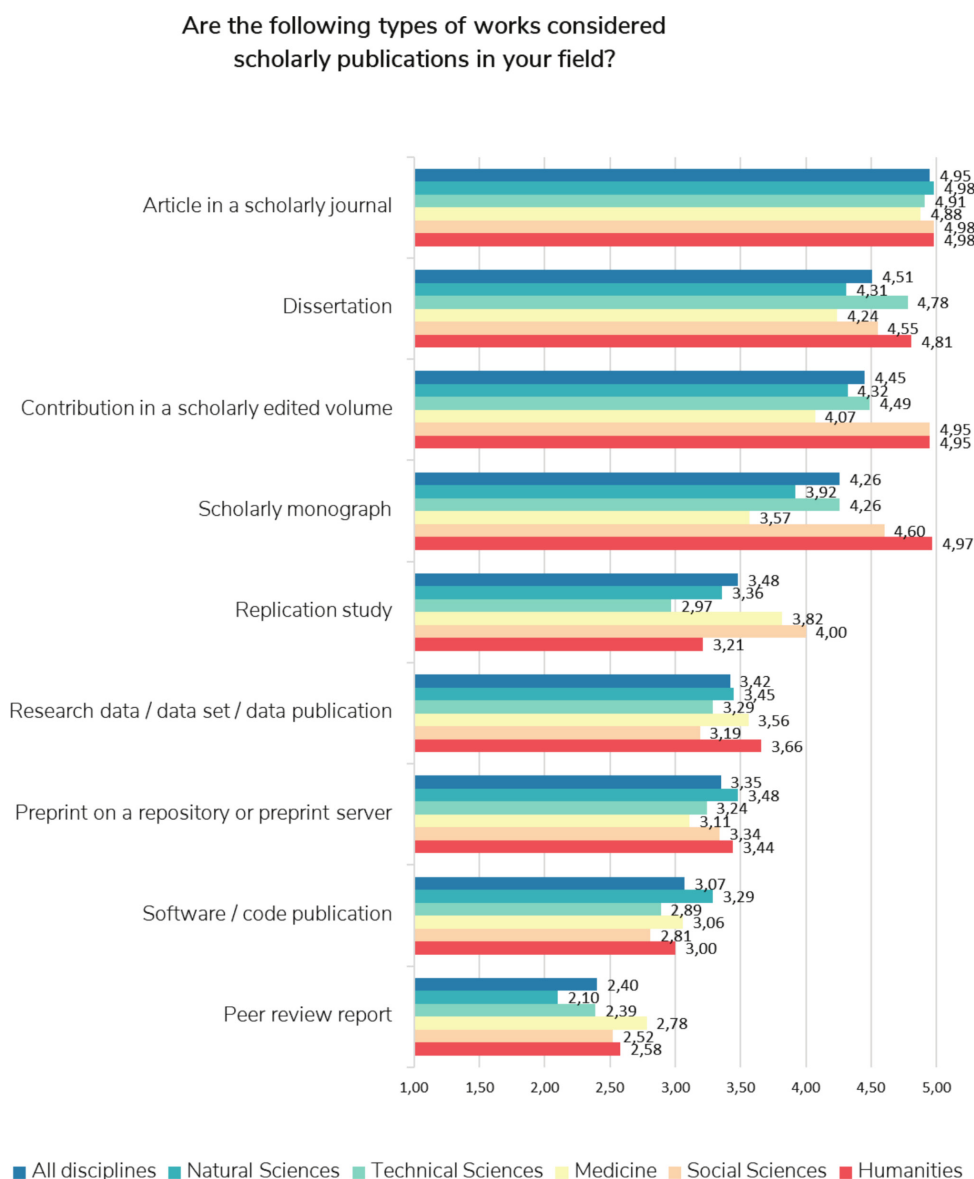
FIGURE 4 | Recognition of selected (best established and 'novel') publication types (by discipline, main disciplines only; 1 = 'no', 5 = 'yes'; the response option 'does not occur in my field' is not displayed here).

options were 'no opinion' and 'does not occur in my field'. The latter two were used inconsistently across the 30 proposed publication types, which made a nuanced view of the approval rates necessary.

Respondents were particularly in favour of increased future recognition for research data/data sets/data publications (38%) and teaching materials/tutorials/OER (38%). At the same time, a significant proportion of the respondents (28%) believe that teaching materials/tutorials/OER should not be more widely recognised in the future.

There was also substantial support for increased recognition of replication studies (30%) and software/code publications (29%), two types of work often mentioned in discussions on research assessment. At the same time, a considerable proportion of respondents (43% each) indicated 'does not occur in my field' or 'no opinion'. Notably, these types of work had the lowest rates of opposition to increased recognition in the future. This shows

that support for greater recognition of these types of work is particularly strong in disciplines where they occur.

Opinion was similarly divided for scholarly videos, contributions to non-scholarly journals, and scholarly podcasts as for teaching materials/tutorials/OER; here, however, the balance was negative, with opposition slightly outweighing support.

Annotations (6%) and registered reports (12%)—both common in only a few disciplines—received the least support for increased future recognition, each with a very high proportion of 'no opinion' (40% and 39%, respectively). Similarly, expert opinions (11%) and contributions to catalogues (11%) also received little support for increased recognition. Many respondents indicated that these types of work 'do not occur in their field' (21% and 31% respectively).

Conference posters (53%), conference abstracts (47%), conference slides (34%), and preprints (33%) were considered to be 'already
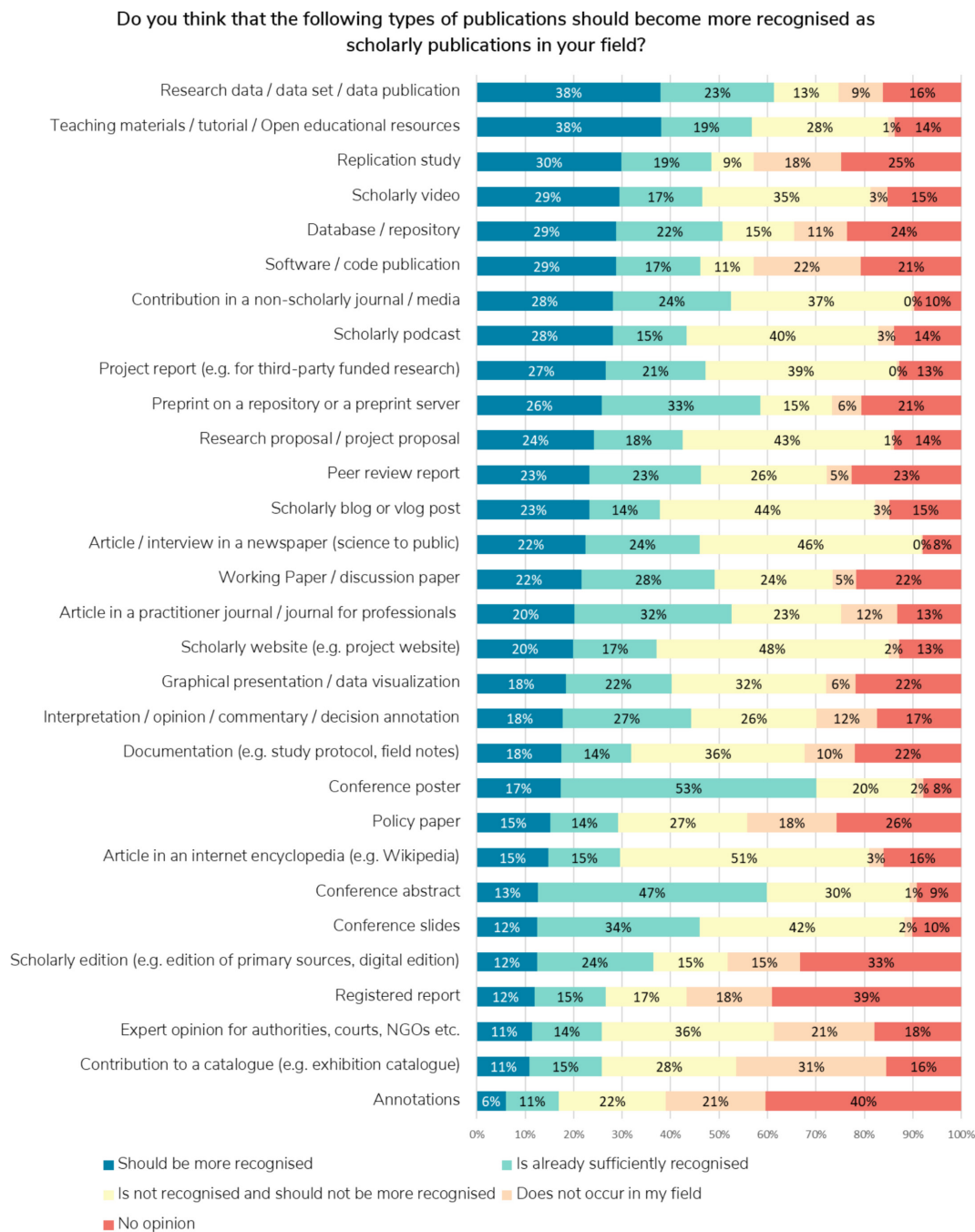
FIGURE 5 | Types of work that should receive more recognition as scholarly publications in the future (all participants; 1 = 'should be more recognised', 2 = 'is already sufficiently recognised', 3 = 'is not recognised and should not be more recognised', 4 = 'does not occur in my field', 5 = 'no opinion'; *n* = 598–612).

sufficiently recognised' by a large share of participants. Articles in internet encyclopaedias (51%), scholarly websites (48%), articles/interviews in newspapers (46%), and scholarly blog/vlog posts (44%), types often used for science-to-public communication, were often classed as 'not recognised and should not be more recognised'.

3.3.1 | Results by Main Discipline

For this analysis, we selected a subset of publication types that frequently appear in discussions about research assessment

(Figure 6). For the sake of clarity, the analysis mainly focuses on the response option 'should be more recognised'. The following significant differences between the main disciplines stand out:

For software/code publications, there is significant support for increased future recognition in the natural sciences (39%) and technical sciences (35%). Many respondents from the social sciences (29%) and humanities (41%) indicated that software/code publications do not occur in their field. Replication studies received strong support for more future recognition in natural sciences (36%), medicine (42%), and social sciences (37%), and little

Do you think that the following types of publications should become more recognised as scholarly publications in your field?
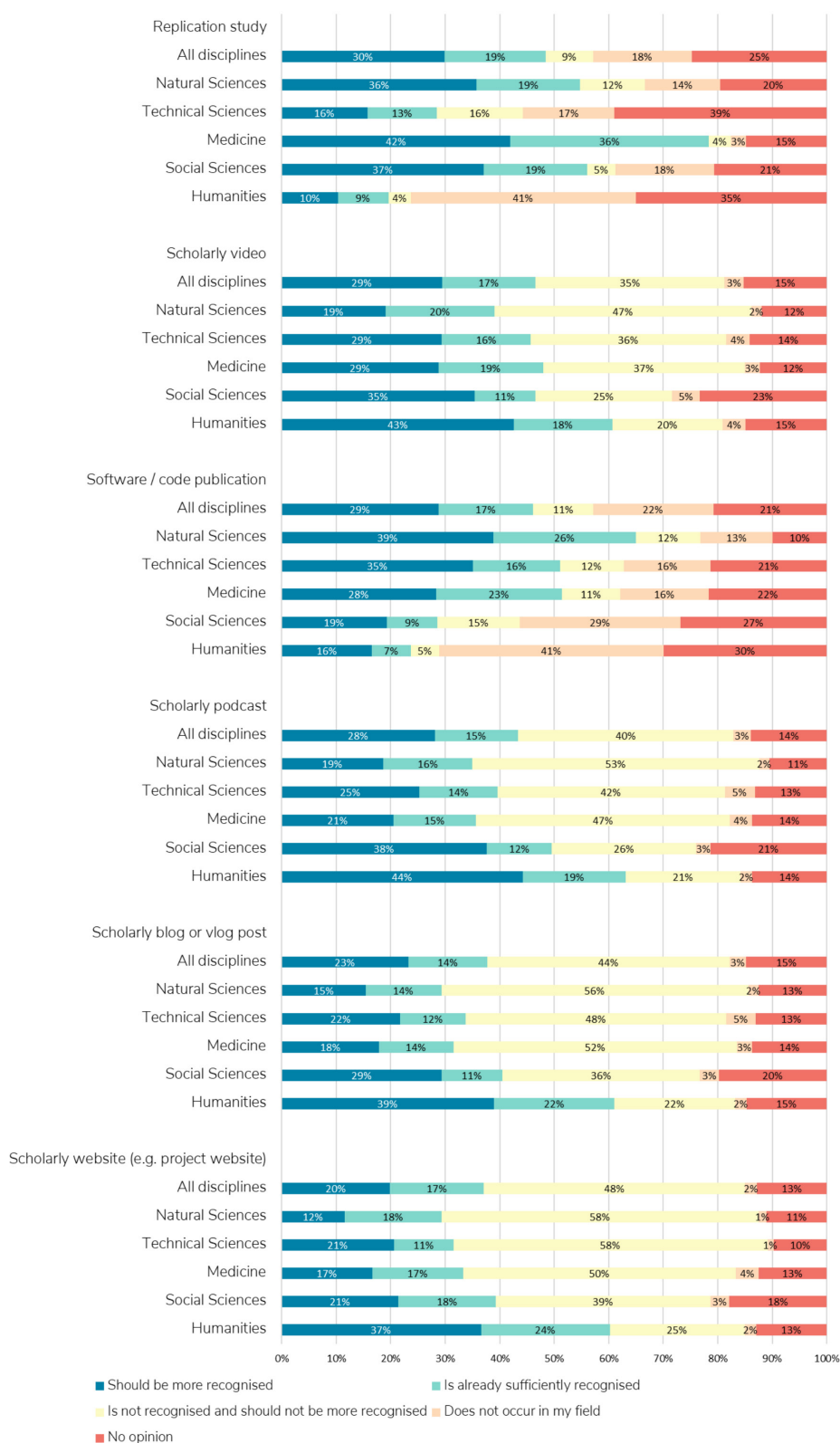
FIGURE 6 | Types of work that should receive more recognition as scholarly publications in the future (selected types, by discipline, main disciplines only; 1 = 'should be more recognised', 2 = 'is already sufficiently recognised', 3 = 'is not recognised and should not be recognised', 4 = 'does not occur in my field', 5 = 'no opinion').

support and high 'no opinion' rates in the technical sciences (16%, 39%) and the humanities (10%, 35%).

For science-to-public formats, the humanities and social sciences support greater future recognition of scholarly websites, scholarly blog/vlog posts, scholarly podcasts, and scholarly videos more than other disciplines.

Contrary to our initial hypothesis that researchers in the natural sciences would be more open to recognising novel publication types, we did not find significant differences between disciplines for research data/data sets/data publications, teaching materials/tutorials/OER, preprints, or graphical presentations/data visualisations.

3.3.2 | Results by Career Stage

As before, we selected publication types that are frequently discussed in research assessment and focused our analysis on the response option 'should be more recognised' (Figure 7).

It became apparent that professors are more reluctant than post-docs and pre-docs to give more recognition to a number of 'novel' or innovative types of work and to science-to-public publication types (Figure 7). This was the case for teaching materials/tutorials/OER, replication studies, graphical presentations/data visualisations, and scholarly websites and videos. For research data/data sets/data publications and software/code publications, the results also suggest stronger support for more recognition from pre-docs and post-docs compared to professors, but are not statistically significant, as is also the case for many other types of work.

Post-docs and pre-docs were generally more likely than professors to express 'no opinion' on publication types. In contrast, professors were more likely to indicate that certain types of work, such as graphical presentations/data visualisations, 'should not be more recognised' in the future.

3.4 | Summary of Further Aspects of Scholarly Publications

In our survey, we also asked participants about the authors and target groups of scholarly publications, as well as who decides which works are recognised as scholarly publications.

3.4.1 | Authors

Two questions in our survey investigated the professional background of the authors of scholarly publications. We asked about the importance of the author's professional status and reputation for recognition as a scholarly publication. According to the survey participants, these factors are not very relevant ($M = 2.57$). There were no significant differences between the disciplines or career stages in response to this question.

Additionally, we investigated whether publications by authors with different professional backgrounds were considered to be scholarly publications (Figure 8). Works by authors who are members of academic institutions are most likely to be considered scholarly publications. Notably, the rating ($M = 4.32$) is well below the maximum value. Publications by non-academics (e.g., autodidacts) are least likely to be considered scholarly publications.

In the natural sciences, technical sciences, and medicine, publications by staff of corporate research departments were more likely to be considered scholarly publications than in the humanities and social sciences. There were no significant differences between the responses of professors, post-docs, and pre-docs.

3.4.2 | Target Groups

Participants were asked to indicate the target audience for scholarly publications in their field (Figure 9). They indicated that scholarly publications are primarily aimed at colleagues in their own academic field ($M = 4.85$). Researchers from other academic fields come second, but by a wide margin, followed by students and practitioners.

Scholarly publications are thus used for peer-to-peer communication rather than for communicating science to the public. All other target groups, including the general public, amateur researchers, industry, politics, and business, have a much lower rating.

There were no significant differences between the main disciplines with regard to peers from the same discipline or researchers from other disciplines as target groups for scholarly publications. However, there was considerable variation regarding the relevance of all other proposed target groups (Figure 10). In the natural sciences, not only the general public, interest groups/NGOs, policymakers and politicians but also practitioners and professionals are rated below average as target groups for scholarly publications. In the technical sciences, industry and the economy/businesses have above-average relevance as target groups. In medicine, practitioners and professionals, such as physicians, and interest groups/NGOs received above-average ratings. In the humanities, students, the general public and amateur researchers were rated more important as target groups than in any other discipline, while industry and the economy/businesses are of little relevance. In the humanities and the social sciences, the general public and amateur researchers are more relevant as target groups than for the other disciplines. Social science researchers indicated that practitioners/professionals, policymakers/politicians, interest groups/NGOs and the economy/businesses are important target groups for their publications.

Comparing professors, post-docs, and pre-docs, we found no significantly different views on any of the mentioned target groups.

3.4.3 | Who Decides What Counts as a Scholarly Publication?

We asked researchers about the factors that determine whether a publication is recognised as a scholarly publication
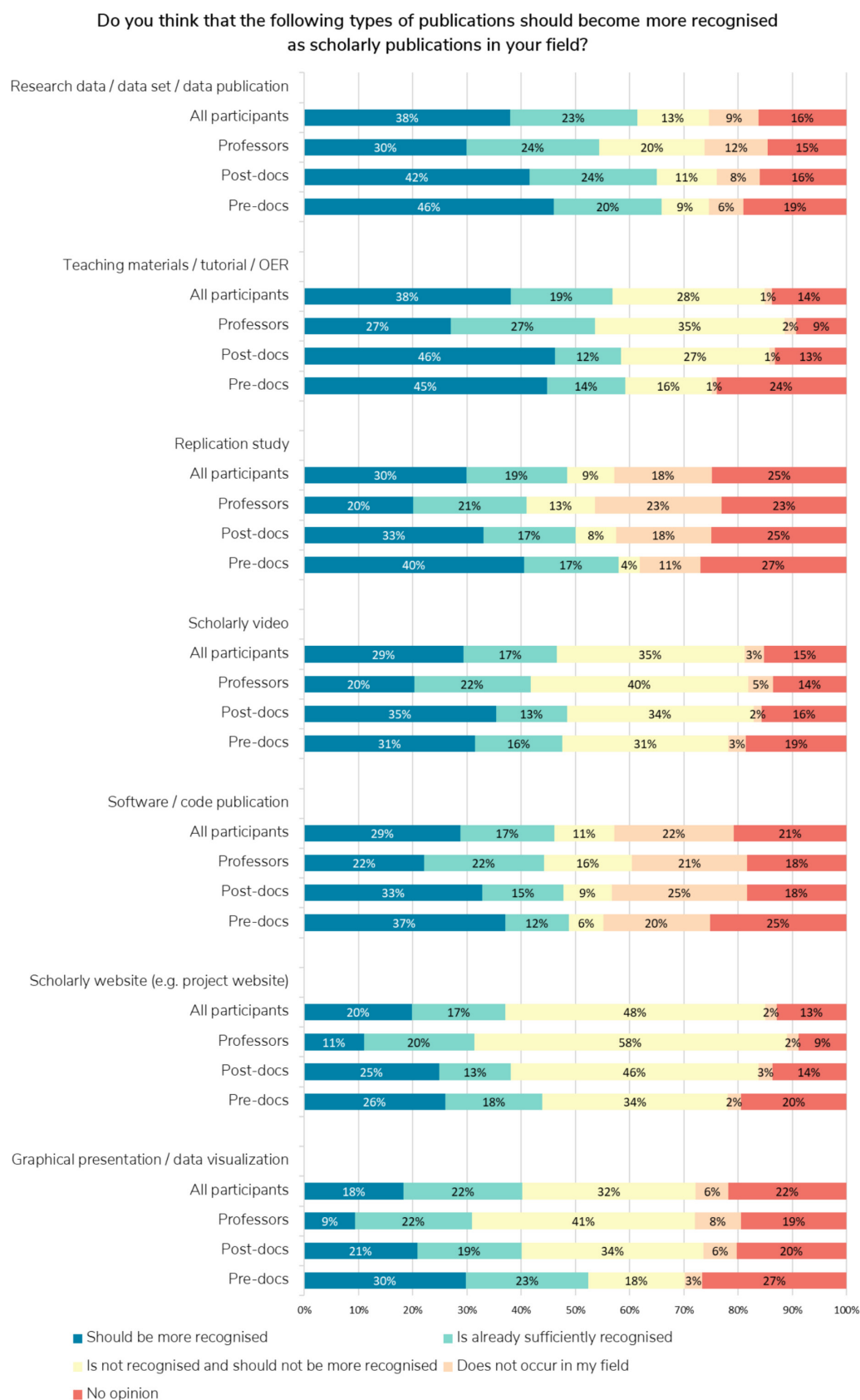
FIGURE 7 | Types of work that should receive more recognition as scholarly publications in the future (selected types, by career stage, excluding 'other'; 1 = 'should be more recognised', 2 = 'is already sufficiently recognised', 3 = 'is not recognised and should not be more recognised', 4 = 'does not occur in my field', 5 = 'no opinion').

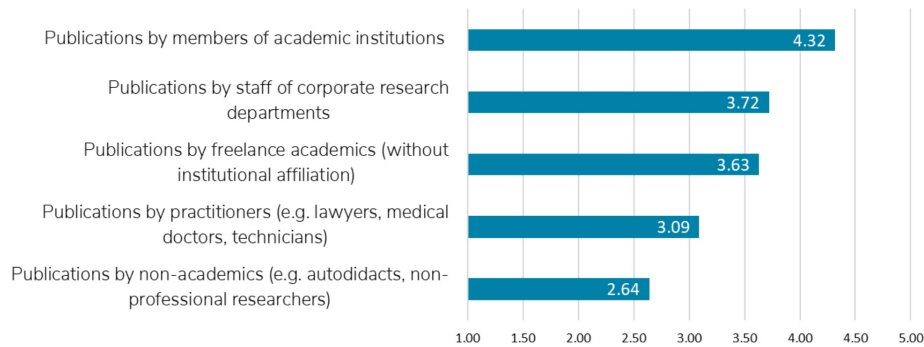## Would you assume that publications by authors with the following professional backgrounds are scholarly publications?

FIGURE 8 | Role of the author's professional background in the recognition of scholarly publications (all participants; 1 = 'no', 5 = 'yes'; n = 613–615).

Do scholarly publications in your field address the following audiences?
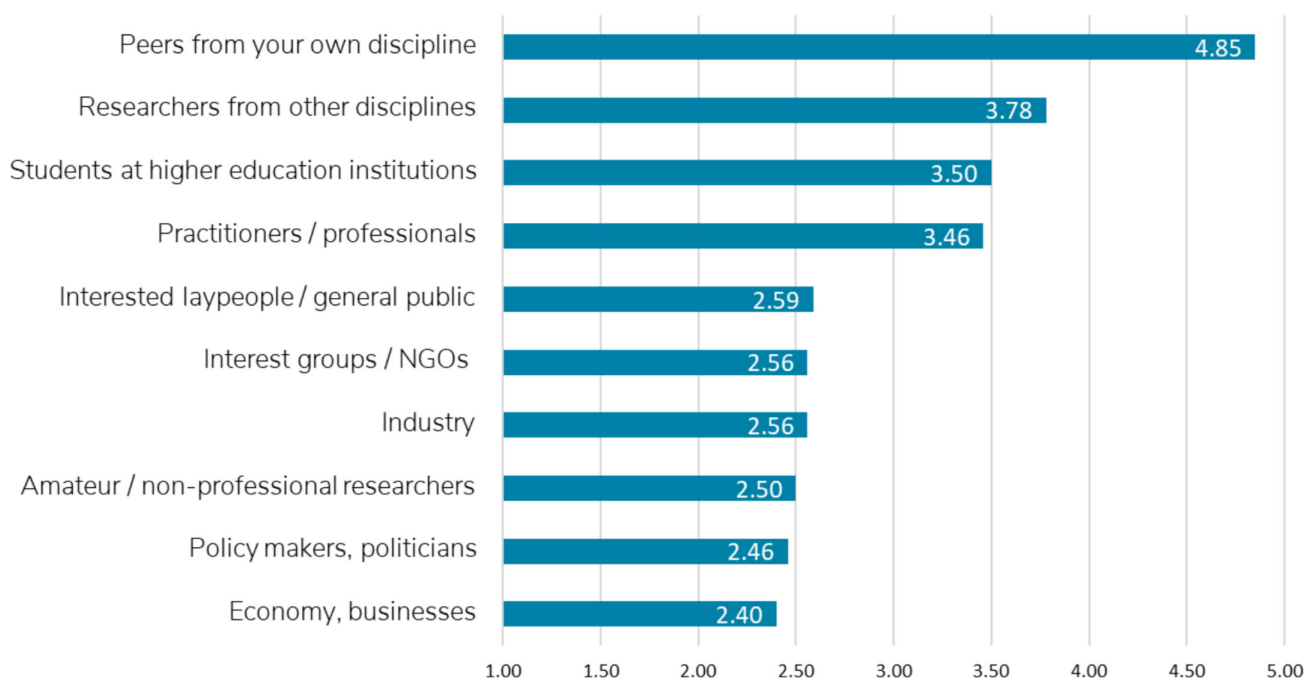
FIGURE 9 | Target groups of scholarly publications (all participants; 1 = 'no', 5 = 'yes'; n = 612–615).

(Figure 11). Recognition by the professional community emerged as the most important factor (M = 4.61). This is consistent with the importance of peers from one's own discipline as a target group (see Figure 9). Inclusion in publication databases and inclusion in institutional research information systems were ranked second and third, a considerable distance behind. Surprisingly, recognition by the Ministry of Science, which is essential as part of the performance evaluation of Austrian universities ('Wissensbilanz'; intellectual capital report), was considered the least important of all the suggested options.

The relative importance of the different factors varies between the main disciplines (Figure 12): In the natural sciences, five of the six factors suggested were rated below average, while there was strong agreement that one's own professional community decides what counts as a scholarly publication. In medicine,

inclusion in publication databases is more important than in any other main discipline and even more important than recognition by the professional community. Inclusion in publication databases is perceived as less important in the humanities than in all other disciplines.

Professors rate both recognition by the Ministry of Science and the institutional research information system as significantly less relevant than post-docs and pre-docs. For the other options, the differences between the career stages are not statistically significant.

3.5 | Confirmatory Hypothesis Tests

Our study included a range of non-traditional and novel publication types, including preprints, research data/data sets/
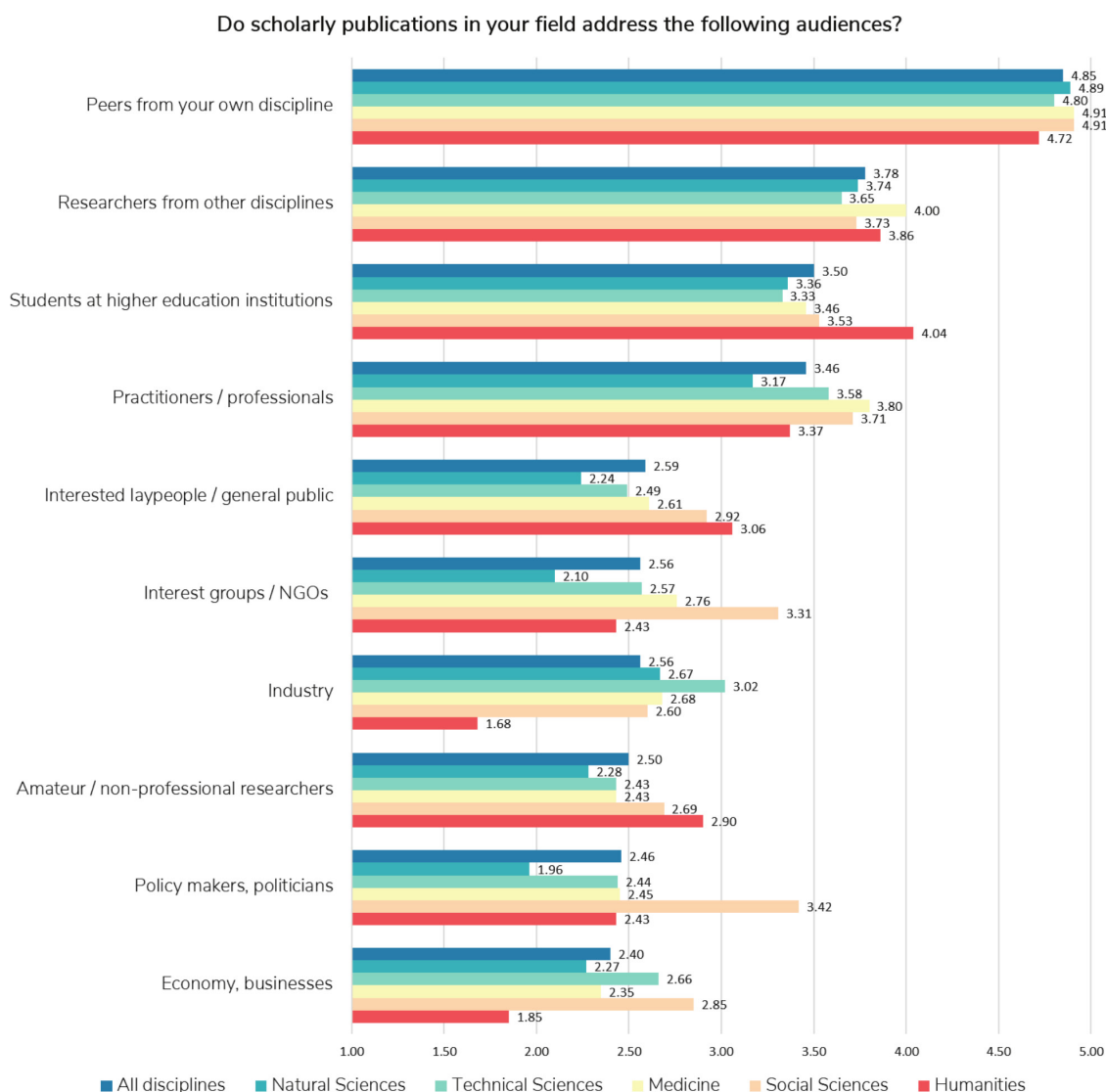
FIGURE 10 | Target groups of scholarly publications (by discipline, main disciplines only; 1 = 'no' to 5 = 'yes').
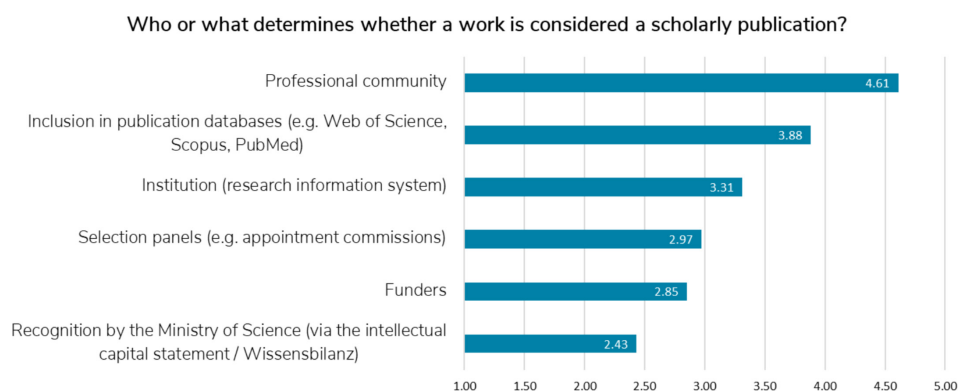

FIGURE 11 | Factors for recognition of a work as a scholarly publication (all participants; 1 = 'not decisive' to 5 = 'very decisive'; $n = 605–610$).

data publications, databases/repositories, software/code publications, replication studies, peer review reports (when a peer review of a study is being published alongside the study itself), teaching materials/tutorials/OER, and scholarly blog/vlog posts.

We hypothesised[9] that these publication types would be recognised more by natural scientists (compared to social scientists and humanities scholars) and younger scientists (pre-docs and post-docs rather than professors). To test this, we submitted the ratings of these newer publication types to two statistical

models, using the scholarly disciplines and academic positions of the participants as independent variables.

We employed ANOVAs to assess current recognition and Chi² logistic regressions to predict future recognition, but we only did so when the individual tests showed a statistically significant result with the conservative threshold in order to avoid false positives due to multiple tests ($p < 0.001$). We then tested both predictors (status and field) in one model and checked whether the results supported the hypothesis.

As can be seen from Table 1 (left side), we found greater recognition of peer review reports, replication studies and scholarly blog/vlog posts as scholarly publications among younger researchers. Likewise, scholarly blog/vlog posts receive more recognition in the natural sciences than in the social sciences and
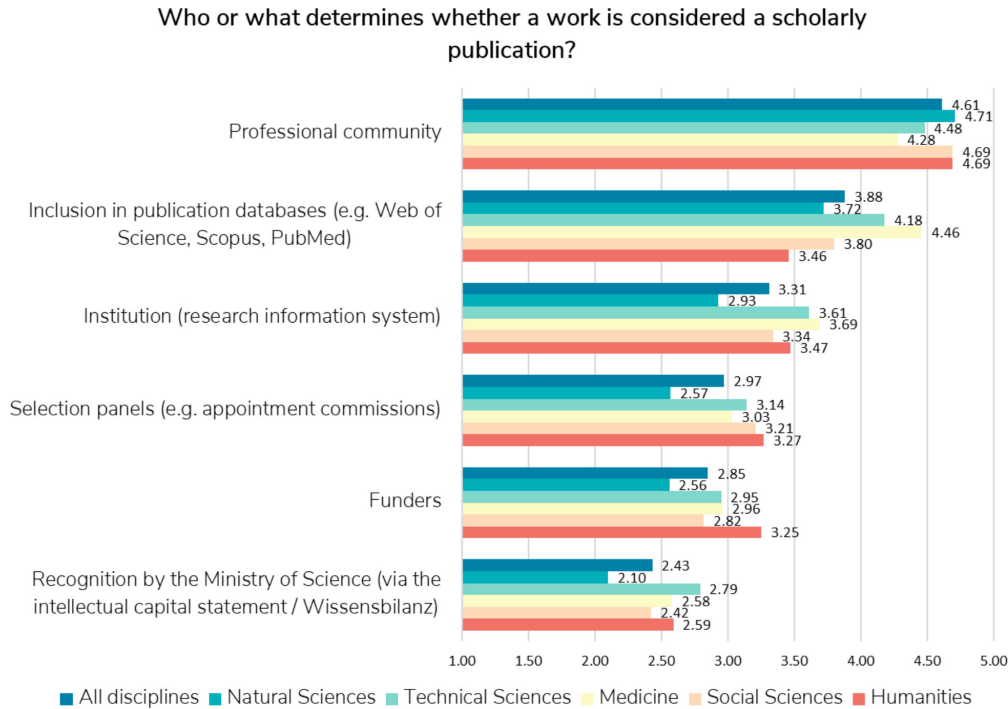
FIGURE 12 | Criteria for determining a scholarly publication (by discipline, main disciplines only; 1 = 'not decisive' to 5 = 'very decisive').

TABLE 1 | Summary of the confirmatory analysis.

	Types				Support		Future types				Support	
	Field		Status				Field		Status			
	F^*	p	F^{**}	p	H1	H2	χ^{2*}	p	χ^{2**}	p	H1	H2
Preprint on a repository or preprint server	1.483	0.206	3.163	0.024	—	—	1.547	0.818	7.476	0.058	—	—
Research data/data set/data publication	1.654	0.159	3.817	0.01	—	—	6.993	0.136	11.341	0.01	—	—
Software/code publication	1.989	0.095	1.022	0.383	—	—	24.208	<0.001	11.073	0.011	Yes	Yes
Database/repository	3.435	0.009	1.73	0.16	—	—	7.156	0.128	9.773	0.021	—	—
Peer review report	4.232	0.002	8.192	<0.001	No	Yes	13.155	0.011	4.917	0.178	—	—
Replication study	6.32	<0.001	5.772	<0.001	No	Yes	38.401	<0.001	18.894	<0.001	No	Yes
Scholarly blog/vlog post	15.504	<0.001	3.134	0.025	Yes	Yes	24.018	<0.001	15.208	0.002	No[#]	Yes
Teaching materials/tutorials/OER	—	—	—	—	—	—	5.66	0.226	20.279	<0.001	No[#]	Yes

Note: *(df = 4), **(df = 3), minimum to maximum sample size per analysis: $n = 393$–595, # statistically significant evidence points in the opposite direction than expected.

the humanities. Regarding future recognition (see[10], Table 1, right side), younger researchers also indicated that software/code publications, replication studies, scholarly blog/vlog posts and teaching materials/tutorials/OER should be recognised more as scholarly publications, partially confirming H2. However, only software/code publications were deemed acceptable as a type of scholarly publication by respondents from the natural sciences. Contrary to H1, respondents from the social sciences and humanities agreed to a greater extent than others that teaching materials/tutorials/OER and scholarly blog/vlog posts should receive more recognition in the future.

These findings support our hypothesis (H2) that younger researchers are more open to (at least some) novel publication types. However, we found less support for H1, indicating that fields and disciplines vary more than assumed regarding the acceptance of novel publication types.

4 | Discussion and Conclusions

Publications play a key role in scholarly communication, research assessment, and, thus, researchers′ careers. Even so, existing definitions of what constitutes a scholarly publication are vague. Our survey explored the perspectives of researchers on aspects such as defining criteria, types, and future recognition of different types of scholarly publication.

4.1 | Key Results

4.1.1 | Criteria

Our study showed that a wide range of characteristics or criteria are relevant for the recognition of a scholarly publication. Of the 25 criteria we included, 19 were rated as 'rather important' or 'very important'. Generally, researchers prioritise content-related criteria over formal criteria. The survey participants rated a transparent and comprehensible methodology as the most important criterion, while, interestingly, this criterion has not been emphasised particularly in the relevant literature. Adherence to good scientific practice, clearly identifiable authors, and comprehensible argumentation were also rated highly. It is possible that social desirability bias influenced responses to certain criteria, such as adherence to good scientific practice. Researchers may have been inclined to give answers that align with social norms and expectations.

In contrast, most of the formal criteria, such as publication date stated, persistent identifier, and careful linguistic and formal presentation, were generally considered less important by the respondents. The reputation of the journal and/or publisher ($M = 3.76$) is not given much weight either, which seems to contradict current practices. However, participants may have perceived the wording 'journal/publisher' as ambiguous.

Our results are, therefore, only partially consistent with the criteria described as central in the literature (see literature review). For example, transparent and comprehensible methodology was more important to respondents than indicated in the literature. On the other hand, criteria such as contributing to the current

state of research and peer review were considered less important than previous studies (Dougherty 2018) found.

4.1.2 | Types

As could be expected, traditional publication types such as journal articles, scholarly monographs, and conference proceedings, which are also core elements of publication databases and research information systems, remain the most widely recognised among researchers. Interestingly, dissertations were rated higher than habilitations (postdoctoral theses). Novel publication types, such as replication studies, research data/data sets/data publications, preprints, software/code publications, and databases/repositories, are more widely recognised as scholarly publications than science-to-public types, such as contributions to non-scholarly journals or newspapers. The demand to recognise these types of work as scholarly publications is limited among researchers, despite the increasing emphasis on science-to-public activities from funders and in research politics. However, these types of work may be recognised as other forms of research output. Text-based publication types generally receive greater recognition than multimedia types such as scholarly videos or podcasts. Less formal publication types (reports on conferences/symposia, departmental publications, articles in a non-scholarly journal/medium), which typically lack formal peer review, were not widely accepted as scholarly publications.

Discipline-specific publication types (legal commentaries, expert opinions for authorities, courts, etc.) generally received lower ratings. In the natural sciences and medicine, comparatively few types of work are recognised as scholarly publications. In contrast, more types of scholarly publication are recognised in the humanities than in any other discipline, including a range of potential science-to-public formats.

4.1.3 | Future

Researchers expressed a desire for different types of work to be more widely recognised in the future. The responses varied greatly depending on the discipline. Overall, the desire for research data/data sets/data publications (38%), teaching materials/tutorials/OER (38%), replication studies, and software/code publications to be more widely recognised was most pronounced. It is noteworthy that research data/data sets/data publications and replication studies, which ranked first and third, are types inherently connected to quality aspects.

Conference posters, conference abstracts, conference slides, and preprints were considered 'already sufficiently recognised'. Other types of work, many of them with a focus on science-to-public communication, were classed as ′not recognised and should not be more recognised′. While there is a growing demand for novel types of work to receive more recognition as scholarly publications in the future than they currently do, this does not appear to apply to science-to-public types.

Researchers in medicine and the social and natural sciences tend to support greater recognition of replication studies, while the natural and technical sciences call for increased recognition of

software/code publications in the future. For discipline-specific publication types, there is a high proportion of 'no opinion' and 'does not occur in my field'.

4.1.4 | Authors, Target Groups, Decision Makers

The results regarding authors and target groups show that scholarly publications are primarily written by and for the scientific community and seldom by and for the general public and people outside the research community. Students and practitioners are considered important target groups for scholarly publications, while the relevance of various target groups differs a lot between disciplines.

Contrary to our expectations, the participants indicated that the professional position and reputation of the author are not particularly relevant in classifying a work as a scholarly publication, even though an author's reputation is crucial in academic practice. (Ray et al. 2022, 159).

According to researchers, the scientific community's opinion is the most important factor in recognising a work as a scholarly publication, even more important than its being indexed in publication databases such as Web of Science and Scopus.

4.1.5 | Differences Between Disciplines

The results above refer to the responses of all the participants. However, there are significant differences between the disciplines. These differences concern publication types and their future recognition, as well as target audiences and the factors determining whether a publication is recognised as a scholarly publication. These differences between disciplines must be considered when interpreting the overall results.

Researchers in the natural sciences and medicine recognise significantly fewer publication types as scholarly publications than those in the other disciplines. The call for future recognition of novel publication types is specific to particular fields. The most significant differences in publication cultures lie between the fields of medicine and the humanities.

These findings highlight the fact that a one-size-fits-all approach may not be appropriate. A more nuanced, subject-specific approach to research assessment and documentation is required.

4.1.6 | Career Stages

Professors are more restrictive than post-docs and pre-docs in recognising publication types. They value traditional types more. Post-docs and pre-docs, who tend to be younger researchers, are more open to the future recognition of 'novel' publication types alongside traditional ones. This finding aligns with the broader discussion on alternative research assessment and the need to consider a wider range of research outputs in the future. On other topics, such as authors and target groups, there were no significant differences between responses from people at different career stages.

4.2 | Recommendations

4.2.1 | Additional Types of Work Should be Considered in Research Assessment and Documentation

Our survey shows that, in particular, research data/data sets/data publications and teaching materials/tutorials/OER, as well as replication studies and software/code publications, are increasingly seen as relevant and, therefore, citable research outputs by many researchers, especially pre-docs and post-docs. However, these types of work are not yet fully recognised as scholarly publications or included in the scholarly record.

Given the value of these publication types to researchers, as evident in our survey, more attention should be accorded to them in future research assessment. There is a growing imperative for publication databases, research information systems, and long-term archiving to accommodate these novel types of publication. Libraries should expand their research support resources and funding opportunities correspondingly. This could include services such as dedicated workshops and support covering the publication of data, software, or code, as well as providing funding to cover costs, for example, for data publications.

4.2.2 | More Subject-Specific Research Documentation, Assessment and Support Are Needed

Our findings highlight multiple differences between disciplines around the concept of 'scholarly publications'. However, while traditional publication types, such as journal articles, are regularly considered in research assessment, documentation and support, novel and discipline-specific publication types are often neglected. This works against the researchers' desire to decide as a community on the recognition of scholarly publications.

There is a clear need for a more inclusive and adaptable approach to these publication types, for example, when considering decisions on staff appointments and funding allocations. This is in line with ongoing efforts by CoARA and similar initiatives to include a wider variety of types of work in research assessment.

Similarly, publication databases and research information and archiving systems should take the disciplines' differing publication cultures into account when recording, documenting, and archiving scholarly publications.

Institutional research support, publication and career advice, and publication funding should be tailored to account for discipline-specific publication types.

Archiving infrastructures may need increased storage capacity and appropriate metadata schemas to accommodate additional data-intensive publication types.

4.3 | Limitations and Future Directions

Our survey focused on scholarly publications as an element of research assessment and recognition. However, it turned out to be difficult to distinguish between publications and other forms

of research performance and outputs that may be part of the scholarly record. While we decided to consider a wide range of scholarly output as potential publications in our survey, future research could explore the definition of 'scholarly publications' as distinct from the larger concept of 'scholarly output'.

Furthermore, although we collected data at the discipline level, we would have needed more participants to draw conclusions about publications in specific disciplines. Our data suggest that a more granular analysis would help identify variations between the various disciplines and research cultures in more detail.

Consent

This study was approved by the University of Graz Data Protection Office, where we indicated that no personal or sensitive data would be collected during this study. In accordance with the General Data Protection Regulation, participants were required to give their informed consent at the beginning of the survey before being allowed to proceed. Access to the data of participants was restricted to the investigating team and was removed before analysis of the results.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The preregistration can be found here: https://osf.io/2tpcz/. All materials, code and anonymised data are available here: https://osf.io/vn8gf/

Endnotes

[1] Australia's national research evaluation framework Excellence in Research for Australia (ERA) distinguishes traditional (books, chapters in research books, journal articles, and conference publications) from non-traditional types of research output (original creative works, live performance of creative works, recorded/rendered creative works, curated or produced substantial public exhibitions and events, research reports for an external body, and portfolios). A similar distinction is applied by the REF in the UK (https://2021.ref.ac.uk/media/1447/ref-2019_01-guidance-on-submissions.pdf, 102–113; https://www.researchprofessionalnews.com/rr-news-uk-views-of-the-uk-2025-february-look-beyond-papers-for-a-better-ref-and-research-culture/).

[2] https://orcid.org/.

[3] The pre-study was conducted from April to May 2023 among researchers from the four universities in Graz, and was answered in full by 187 researchers. For full details of the pre-study, see the Supporting Information.

[4] At the beginning of the main study, participants gave their informed consent in line with the GDPR. This study was approved by the University of Graz Data Protection Office, where we indicated that no personal or sensitive data would be collected during this study. The full survey questionnaire with all options for each of the blocks can be found here: https://osf.io/tu4qy.

[5] Respondents by main discipline: https://osf.io/cr6v3.

[6] Supporting Information Document 1: Additional Information on the Pre-Study and the Main Study and additional Figures and Supporting Information Document 2: Additional Information for the Main Study.

[7] Preregistration: https://osf.io/2tpcz.

[8] Supporting Information Document 1: Additional Information on the Pre-Study and the Main Study and additional Figures and Supporting Information Document 2: Additional Information for the Main Study.

[9] During the preregistration, we falsely indicated that these publication types are also mentioned among the publication criteria (see Chapter 3.1.), which is not the case. Therefore, the confirmatory tests were conducted for current and future publication types only.

[10] Confirmatory analysis: https://osf.io/82bjk.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1. Data S2.**