INTERNATIONAL DESIGN CONFERENCE - DESIGN 2022
https://doi.org/10.1017/pds.2022.131

Is Anybody Listening? A Citation Analysis of Healthcare Design Research Articles Published in Design Journals

G. Lamé [1,✉], S. Huynh-Dagher [1], A. Komashie [2,3], M. Jankovic [1] and T.-A. Duong [4,5]

[1] CentraleSupélec, France, [2] University of Cambridge, United Kingdom, [3] THIS Institute, University of Cambridge, United Kingdom, [4] AP-HP. Université Paris-Saclay, France, [5] Université Paris Est Créteil, France

✉ guillaume.lame@centralesupelec.fr

Abstract

Citation is a key metric in academia, and it can help to understand how ideas travel between disciplines. In this article, we report on a citation analysis of forty-four articles identified during a systematic literature review of healthcare design research published in six leading design journals. Using the Web of Science's categorisation of journals, we analyse which disciplines cite these forty-four articles. We find that these articles are much more cited in technology and engineering journals than in health sciences. We discuss these findings and the limitations of the study.

Keywords: healthcare design, design research, research methodologies and methods, multi-/cross-/trans-disciplinary approaches

1. Introduction

Evidence of engagement between design and health in the academic literature seems to be lagging behind the progress being made in practice. Several books and reports have been published that attempt to bridge the gap between design, engineering, and health (National Academy of Engineering and Institute of Medicine 2005; Jones 2013; Griffin et al. 2016; Clarkson et al. 2017). Multidisciplinary groups have been set up in various scientific societies, including the Health Systems Design Special Interest Group of the Design Society (https://healthsystems.designsociety.org/). However, analysis of the academic literature shows little evidence of engagement.

Citation is a key metric in academia, showing how much of an impact our publications have on our fellow researchers. Often, the question asked is how many times a publication has been cited. However, analysing who cites publications can also help to understand how ideas travel between disciplines (Pieters and Baumgartner 2002; Mitra et al. 2020). This perspective is important in healthcare. The challenges facing healthcare are complex and multifactorial, and they often require the combination of multiple perspectives to tackle them (Zerhouni 2003; Hall et al. 2006; Smye and Frangi 2021). Design has a contribution to make (Gray 2016; Wears 2017; Clarkson 2018), but to date little is known on the impact of healthcare design research on health scientists.

In this article, we analyse citations for healthcare design research articles identified in six key design journals. We present results on how citations of these articles are distributed between disciplines, at different levels. We then discuss the implications for healthcare design research.

2. Methods

We conducted a focused mapping review and synthesis (FMRS) (Bradbury-Jones et al. 2019) of healthcare design research. FMRS aims at mapping the key themes and methodological characteristics

of a domain of research, rather than aggregating the results on a given topic. The results of the review will be published separately. One distinguishing feature of FMRS is that it involves selecting a set of relevant journals to identify journals.

We selected six key design journals: the *Journal of Engineering Design, Research in Engineering Design, Design Science,* the *International Journal of Design, Design Studies* and *Design Issues*, Cash's arguments that they represent a key sample of design research publications (Cash 2018). We conducted a search on these six journals on Clarivate's Web of Science on 12 October 2020, using the following search string (devised collaboratively by the research team):

> TOPIC: (health OR healthcare OR medic* OR pharma* OR nurs* OR hospital OR doctor OR physician OR patient) AND PUBLICATION NAME: ("journal of engineering design" or "research in engineering design" or "international journal of design" or "design studies" or "design issues" or "design science")

We set no restrictions on dates. We included all articles discussing the application or study of design in healthcare, regardless of study type. Healthcare was defined as the set of services provided by a country or an organization to treat the physically and the mentally ill. Two researchers independently screened articles based on titles and abstracts, and then on full texts. Data extraction will be reported in the review itself and is not relevant here.

We tracked citations of articles included in our review using the Web of Science (WoS, https://www.webofscience.com). We define citations as instances where one of our 44 articles is listed in the reference list of another article. Thus, one citing article can count for multiple citations if it cites more than one of the 44 articles in our sample. In practice, we built a "marked list" with all the articles included in our review. We then generated a "citation report" on 14 September 2021. We analysed this report to identify who cited the articles in our sample. We focused on the disciplines where articles in our sample had been cited, using WoS's own system for categorising publications in disciplines.

WoS uses three hierarchical levels of categorisation of journals:

- Categories (five: Arts & Humanities, Life Sciences & Biomedicine, Physical Sciences, Social Sciences, and Technology)
- Research areas (154)
- WoS Categories (254)

For example, the "Technology" Category contains the Research Area "Engineering", which itself contains WoS Categories ranging from "Engineering, Aerospace" to "Engineering, Petroleum". A publication can belong in one or more WoS Categories, one or more Research areas and one or more Categories. As an illustration, the *International Journal of Design* is listed as follows:

- Technology (Category)
  - Engineering (Research area)
    - Engineering, Manufacturing - SCIE (WoS Category)
    - Engineering, Multidisciplinary - SCIE (WoS Category)
- Arts & Humanities (Category)
  - Art (Research area)
    - Art - AHCI (WoS Category)
- Social Sciences (Category)
  - Social Sciences Other topics (Research area)
    - Social Sciences, Interdisciplinary - SSCI (WoS Category)

We included all types of citing publications, because conference proceedings can be viewed as equally important as journal articles in some disciplines (e.g. computer science). We analysed results excluding self-citations between articles in our sample. We report the number of citations of articles included in our review per Category, Research area and WoS Category.

3. Results

We included 44 articles in our review (the references are listed in Appendix 1 at the end of this article). Table 1 shows how these articles were distributed between the six journals we searched. We

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identified 472 citations for these articles on the WoS, excluding self-citations. Because some publications are categorised in multiple WoS categories, some of these citations will count towards more than one WoS Category, Research area and Category.

Table 1. Number of articles included in our review per journal and WoS categorizations for the six journals covered in our review.

Journal name	Number of articles	WoS categories	Research areas	Categories
Journal of Engineering Design	12	Engineering, Multidisciplinary - SCIE	Engineering	Technology
Research in Engineering Design	1	Engineering, Industrial - SCIE	Engineering	Technology
		Engineering, Manufacturing - SCIE	Engineering	Technology
		Engineering, Multidisciplinary - SCIE	Engineering	Technology
Design Science	2	Engineering, Manufacturing - ESCI	Engineering	Technology
International Journal of Design	15	Social Sciences, Interdisciplinary - SSCI	Social Sciences Other Topics	Social Sciences
		Art - AHCI	Art	Arts & Humanities
		Engineering, Manufacturing - SCIE	Engineering	Technology
		Engineering, Multidisciplinary - SCIE	Engineering	Technology
Design Studies	6	Engineering, Manufacturing - SCIE	Engineering	Technology
		Engineering, Multidisciplinary - SCIE	Engineering	Technology
Design Issues	8	Architecture - AHCI	Architecture	Arts & Humanities

3.1. Categories

On Figure 1, we show the number of articles citing an article in our review, per Category. This view is not directly available on the WoS, so we constructed it by matching citation counts in Research Areas to the Categories to which they belong. Because some journals are indexed in more than one Category, some citations are attributed to more than one Category. The 472 original individual citations become 689 citations in this analysis. Technology" accounts for 46.2% of these 689 citations. "Life Sciences & Biomedicine" comes second with 25.3% of citations, followed by "Social Sciences (19.3%), "Arts & Humanities" (6.5%) and "Physical Sciences" (2.8%).

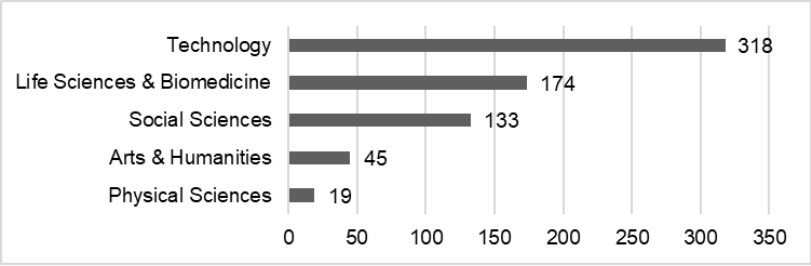

Figure 1. Number of citations per category.

3.2. Research areas

Because some journals are indexed in more than one Research Area, we counted 689 citations across all Research Areas. We identified fifteen research areas with more than ten citations of articles in our

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sample. Figure 2 shows the count of citations for these areas. Engineering is an overwhelming leader, with 28.3% of all citations, followed by Computer Science (8.4%) and Business & Economics (6.8%). Four medical areas appear in this ranking: Health Care Sciences & Services, Public, Environmental & Occupational Health, Rehabilitation and Medical Informatics. Together, they account for 13.8% of all citations.

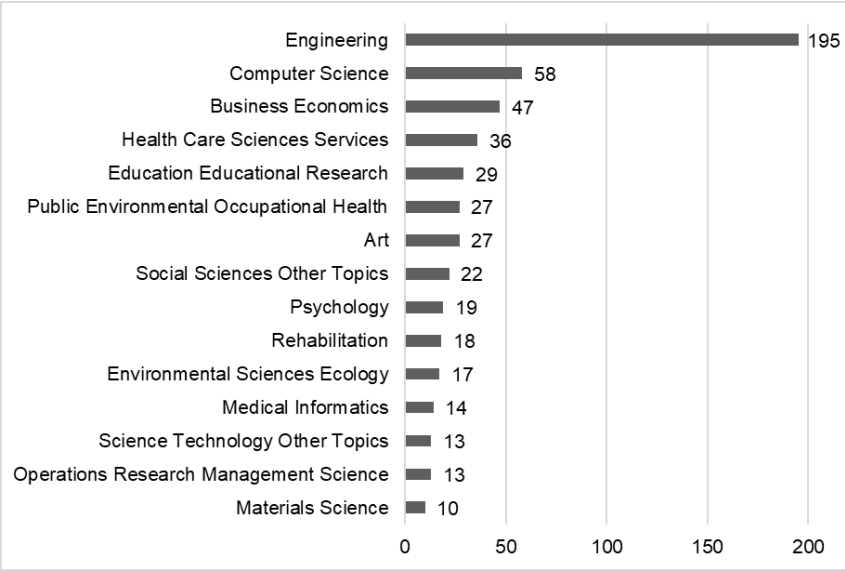

Figure 2. Number of citations per research area, for all research areas with more than ten citations of articles included in our review.

3.3. WoS categories

Because some journals are indexed in more than one WoS category, we counted 836 citations across all WoS categories. Twenty-five WoS categories have more than ten citations of articles in our review (Figure 3). Engineering – Industrial, Engineering – Multidisciplinary and Engineering – Manufacturing are the three WoS categories with most citations. Note that all but one of the six journals covered in our review are listed in at least one of these three WoS categories (with *Research in Engineering Design* listed in all three and *Design Issues* listed in none). Public, Environmental & Occupation Health, Health Care Sciences & Services, Health Policy & Services, Rehabilitation and Medical Informatics are the five healthcare-related disciplines that appear. Of the 836 citations across WoS categories (again, due to some journals being indexed in more than one category), 30 (21.2%) were in WoS categories in the health sciences.

4. Discussion

We have analysed citations of articles included in a systematic review of healthcare design research published in six key design journals. Unsurprisingly, the Technology category and its Engineering Research area are by far the first providers of citations. All but one of the six journals we reviewed are listed in the Technology category and the Engineering Research area (*Design Issues is only listed in the Arts & Humanities category).* Looking at the broad level of Categories, the situation with 174 citations in life Sciences & Biomedicine versus 318 in Technology. However, at this level categories are coarse: the Life Sciences & Biomedicine category includes Research areas such as Fisheries, Environmental Sciences & Ecology, Behavioural Sciences or Anthropology, all far from health sciences. The level of Research areas allows a more precise analysis. The comparison of the 195 citations in Engineering with the 36 in Health Care Sciences & Services, the best ranked health-related Research area, is discomforting.

The question that arises is, should we have expected more citations from health sciences journals? The answer is a matter of judgement. Some design researchers working on healthcare issues may satisfy themselves with being cited by disciplinary colleagues only and going unnoticed by health scientists.

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Nonetheless, recent reports suggest that "impact" is an important issue for at least part of the healthcare design research community (Komashie et al. 2019). If we look at academic impact, our results show that healthcare design research published in design journals finds little echo in health sciences.

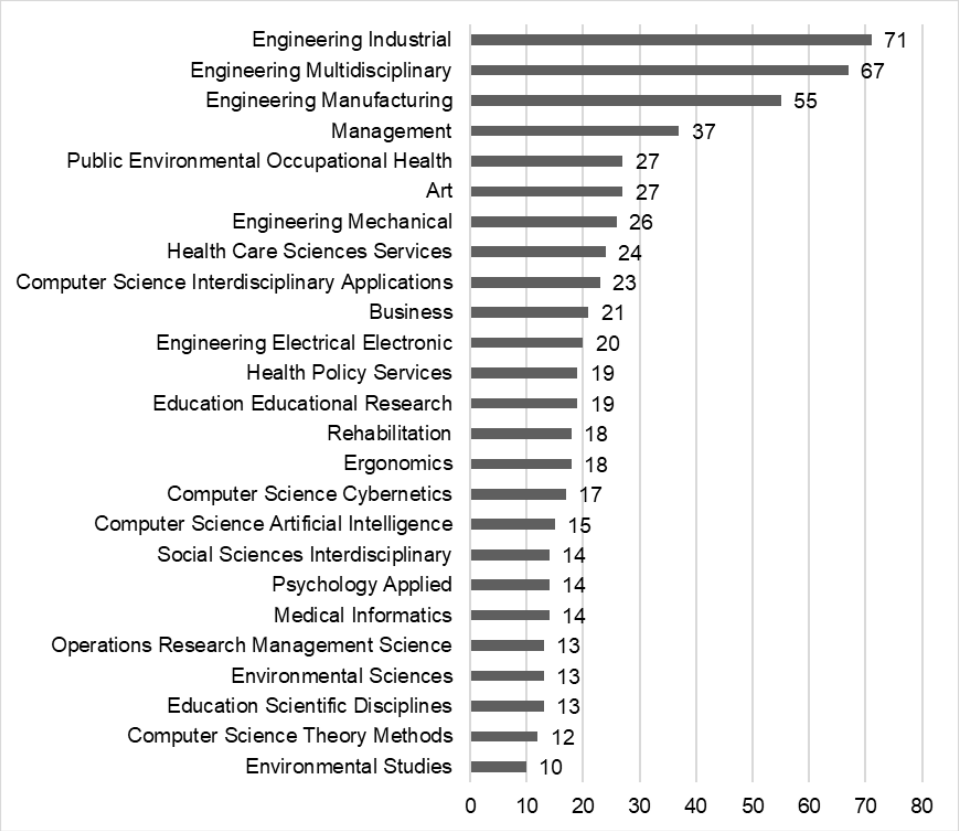

Figure 3. Number of citations per WoS category, for all WoS categories with more than ten citations of articles included in our review.

4.1. Limitations

Our results may be biased by the choice of journals in our review. Maybe we would have had different results if we had included other journals that publish design research, e.g. the *Journal of Mechanical Design* or *CoDesign*. The choice of database for tracking citations is also important. We used the Web of Science. We may have had different results if we had used Scopus, since databases have different coverage (Wanyama et al. 2021). Only additional analyses could measure the impact of these choices. Yet, the six journals we included are leading journals in our field and represent its different trends (Cash 2018), and the Web of Science is a generalist database that includes an extensive list of journals in the health sciences.

An additional source of possible bias is the indexation of some journals in more than one category, which may have skewed our results. None of the six journals we reviewed is included in a healthcare-related category, but some are included in multiple engineering categories, which gives them more weight in the analysis. Yet, at the level of Research Areas, this phenomenon is mitigated by the fact that all engineering WoS Categories are grouped in the Engineering Research Area.

The impact of including conference proceedings would also need to be assessed. Conferences are on par with journal articles in some disciplines, but in others this type of publications could include short abstracts or very short articles.

Finally, the search strategy deserves scrutiny, to assess if we have overlooked important topics. It is not clear, for example, if we may have excluded articles in rehabilitation or biomedical engineering. The support of a librarian would help ensure that we are as exhaustive as possible.

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4.2. Interpretation

Most researchers probably tend to look in familiar places for new evidence. Therefore, it is quite possible that health scientists do not find our research because design journals are not indexed in PubMed, the leading bibliographic database for researchers in the health sciences. However, other signs pointing to a limited uptake of design research in health sciences cannot be explained this way. For example, two systematic reviews of the application of design thinking approaches in healthcare have been published recently; one (Altman et al. 2018) included one of the forty-four article in our review (Lin et al. 2011), the other (Oliveira et al. 2021) included none. A recent systematic review of systems approaches to health service design, delivery and improvement (Komashie et al. 2021) did not include any article from a design journal. The authors of these reviews all searched the Web of Science, which includes five of the six journals in our review, so the reviewers could have identified articles in our sample.

The non-inclusion of healthcare design research published in design journals in these systematic reviews could point to a mismatch in expectations between design researchers and health scientists. Basically, do health scientists like what we are offering? For example, Komashie et al. (2021) conducted a systematic review on the impact of systems approaches on health services. To match generic practices in health sciences, they only included studies that set out to evaluate the *effectiveness* of the systems approach and included a comparator. These constraints effectively exclude a sizeable part of design research. We can frame this difference in expectations using Romme and Reymen's analysis of the activities involved in design science between "science" and "design" in entrepreneurship research, for which they distinguish two concepts (Romme and Reymen 2018):

- "Evaluating" results ("the act of assessing one or more of these research outputs against (value-based) criteria such as usefulness, feasibility, viability, desirability and novelty"), which includes many case study approaches aimed at assessing the practicality of artefacts.
- "Justifying" results ("any effort to enhance the legitimacy of a particular research output, by assessing the research output against criteria such as generalizability, internal and external validity, and reliability"), covering medical research methods like randomised controlled trials.

Design research often puts more weight on the former, whereas health sciences favour the latter. This could explain a lack of uptake of our publications in the health sciences (Lamé 2018). Another explanation is that some healthcare-related articles in our sample do build on case studies in healthcare organisations, but most of their findings are framed in design concepts and appear aimed at the design research community, without much takeaway for health scientists. For example, studies of "design by modification" (Eckert et al. 2012) or idea-screening in stage-gate development processes (Onarheim and Christensen 2012) may not be of direct appeal to health scientists. Yet, other articles seem more directly usable, e.g. when discussing participatory design (Ostergaard et al. 2018; Pierri 2018) or technology-mediated chronic illness management (Kanstrup 2014).

We could maybe expect that researchers in a new and emerging field begin by publishing their boundary spanning work in their disciplinary fields of origin. It does take some time for a subject to mature and a new field to be established. It appears that design research itself has gone through that transition (Forlizzi et al. 2009), and it may not yet be the case for healthcare design research.

A final possible explanation could be that design researchers have different publication strategies depending on their findings and who they are targeting. Design researchers have sometimes published their results directly in journals in the health sciences, e.g. (Jun et al. 2014; Thorpe et al. 2019). Aside from clinical medicine, PubMed covers areas such as ergonomics, biomedical engineering, medical informatics and health services research, where design researchers could publish their results and be more easily identified by health scientists. A broader systematic review would be needed to explore this hypothesis. But even if design researchers published some of their findings directly in health sciences journals, what about the important results in the forty-four articles in our sample? These include contributions on strategic issues like managing patient safety (Clarkson et al. 2004), visualisation techniques for professional activities (Hahn and Zimmermann 2011), engagement with design participants (Lehoux et al. 2011) or critiques or participatory design practices (Pierri 2018).

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The explanations we propose remain speculative and further research is required. In addition to the different approaches to reviewing the literature mentioned above, future work could investigate authors' and editors' decisions through empirical methods. We could explore if editors in design journal tend to reject health-related design articles due to perceived non-relevance, or bias, and how healthcare design researchers decide where to publish their findings. Design journals have a lower impact factor than many healthcare journals, and it is likely to impact authors' decisions. Similarly, open access articles tend to receive more citation, a parameter that could be included in future studies.

5. Conclusion

Our analysis of the academic literature from our designer researchers' perspective shows limited evidence of uptake of design research results in publications in the health sciences. We searched six major design journals to identify 44 healthcare-related studies published since the year 2000. Our analysis of the citations of these studies has shown that most of the citations (46.2%) came from the field of "Technology", which accounted for approximately twice as many citations as "Life Sciences & Biomedicine". This suggests that a gulf persists between design researchers who engage in research in healthcare and health scientists who constitute a legitimate target for (at least some of) this research. Like in "general" design research (Cash 2018), researchers outside of the design research community have successfully developed their own design approaches in healthcare, e.g. in organisational studies and sociology (Robert et al. 2015). We need to better promote our contributions. Recent initiatives show that the community is tackling the issue (Clarkson 2018; Komashie et al. 2019; Pannunzio et al. 2019; Ciccone et al. 2020; Feldman et al. 2020). Nonetheless, for researchers, policymakers and funders, still face the challenge of facilitating effective engagement between the fields of design and healthcare, across traditional disciplinary boundaries.

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Appendix 1. List of the articles included in the systematic literature review

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