

Chapter 17

Mapping the Research Thread of PhDs in Design: A PhD Citation Analysis of the Portuguese Doctorates



Nina Costa, Rui Costa, Afonso Borges, Vasco Branco, Raul Cunha, António Modesto, and Ana Catarina Silva

Abstract The present study undertaken within the DesignOBS project is based on 172 PhD theses in Design submitted to the Portuguese National Design Schools between 2005 and 2019. It focuses in particular on the extraction and analysis of 522 PhD citations appended to design doctoral work. The analysis is used to observe school impact, explore the weight of previous design focused and non-design doctoral work to develop PhD research in design in the country. The results reveal few connections between doctorates and few overlaps in-between as well as outside design schools; thus, indicating poor continuity and reproducibility of domestic doctoral work, little tradition of PhD citation, and an important weight of non-design schools. A network-based visualization of the connections between PhDs in design within PhD thesis, by use of a citation analysis method, enabled to draw reflections on the status of domestic doctoral research in Portugal and provides an empirical approach to explore the reproducibility of this type of research which may be used in other countries.

N. Costa (✉) · R. Costa · A. Borges · V. Branco
Aveiro University, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
e-mail: ndc@ua.pt; ninacostandc@gmail.com

R. Costa
e-mail: ruicosta@ua.pt

V. Branco
e-mail: vasco.branco@ua.pt

R. Cunha
Faculty of Fine Arts, Lisbon University, Largo da Academia Nacional de Belas Artes 4, 1249-058
Lisbon, Portugal

A. Modesto
Faculty of Fine Arts, Porto University, Av. Rodrigues de Freitas 265, 4049-021 Porto, Portugal

A. C. Silva
Polytechnic Institute of Cávado E Do Ave, Lugar Do Aldão, 4750-810 Barcelos, Portugal

17.1 Introduction

Research at universities, regardless of the area of knowledge, is intimately linked to the existence of post-graduate programs [1]. These programs need to be anchored upon a strategic line of thought that provide defined objectives for research and development [2]. Moreover, a discipline is about theories and methods that accumulate through academic research and reflection [3]. Thus, it should establish its grounds in robust and systematic research efforts that expand its knowledge base. In the particular case of design research, this maturation process has evolved quite haphazardly [4]. Characterized as “internally scattered and confused”, the nature and culture of design research is yet an open and evolving debate [4, 5]. Despite the diverse challenges of working within an integrative and inherently multidisciplinary discipline, finding a common corpus of knowledge is important [6, 7]. In the particular case of academic design research, written theses are the most commonly known ways of capturing the whole research process of the study in a single, enduring and searchable medium [8]. Referencing in doctoral—or any—work is central to the growing literature of design research as it helps to support arguments, access common evidence, build the field, and improve the intellectual and practical quality of the discipline [9].

Design education and research is one of the key objects of observation of the “DesignOBS: Towards a design observatory in Portugal” project [11]. It aims to collect, map, and interpret data about the Portuguese Design Ecosystem that may support the creation strategies and policies for its promotion and evolution [10, 11]. Previous studies in DesignOBS looked at the design doctorates undertaken in Portugal and identified a problem regarding their communicability, hampering the quick access to the content, and connections through the most common search cues, i.e., title, keywords, and abstracts [12]. Although useful to provide a first scan of doctoral work in the country, the analysis did not enable the establishment of connections between doctorates in a coherent and meaningful way.

Based on Durling’s [8] argument and the recent criticisms of Margolin and Dorst, this study evolves the previous analysis by exploring the research thread of the PhDs undertaken in Portugal via citation analysis [13]. We focused in particular on exploring only the citations of PhD work (design and non-design focused). The in-degree and modularity scores—typical statistical methods used within network analysis, calculated within Gephi [14]—were included for the creation of the citation network to explore the weight of PhD work across design schools, and identify the connections amongst different communities. By using this method, we were able to gain important insight on some foundational aspects of doctoral research in design, namely its reproducibility and usefulness within academia. Based on these insights, we propose additional guidelines for future design research.

17.2 Background

17.2.1 *PhDs in Design: The Portuguese Case*

Portugal has six national schools that provide doctorate-level degree in design namely, Aveiro University, Faculty of Fine Arts of Porto and Lisbon Universities, Faculty of Architecture of Lisbon, European University, and Beira Interior University. The first thesis in design produced in the country was in 2001 [12]; since early 2010, the number of PhDs has been growing steadily, with new PhD programs being developed (e.g., Fashion Design in University of Beira Interior). Previous work developed within DesignOBS [10–12] focused on making a numerical analysis of design doctorates undertaken in Portugal based on title, key words, and abstracts to understand the scope of design research in the country [12]. The same study concluded, however, that some of the body of knowledge categorized in this area is not always design-focused, but rather more aligned with fine arts, architecture, or sociology. Moreover, some of these doctorates do not mention design in either title, key words, or abstracts [12].

This first effort aimed to depict the PhD design research landscape in the country which was useful to partially corroborate Dorst [4] view of design research via empirical data. However, additional research is needed to trace, visualize, and interpret PhD research in design via empirical data. To address this challenge, this paper combines network analysis with bibliometric studies.

17.2.2 *Networks and Citation Analysis*

A network can be defined as a system of interrelated nodes and edges. In the context of bibliometrics, nodes can be constituted by journals, authors, or other, while edges are the relationship between the nodes. There are mainly two types of relationship: author co-citation, that may reveal the intellectual structure of a field, or collaboration network (or co-authorship) that show the social network of a research field [15]. Networks can be used to identify the intellectual structure of a discipline; the most influential authors, articles or other objects/subjects; explore the influence of specific journals, the core canons within a discipline, consensus and disparities; the flow and knowledge transfer between researchers and institutions and progression of thoughts [16, 17]. The exploration of the properties of a network can be used to extract insights based on empirical data, and drive decision making.

Citation analysis is a specific method within bibliometric studies that can be used to create networks amongst researchers that cite the same article, book, or other document/objects. Each citation originates an edge/line between the source (e.g., author of the PhD work) and the “target” (e.g., authors/co-authors of the items in the bibliography of the PhD); thus, establishing a connection between nodes/objects/subjects. The links created in co-authorship and co-citation networks are different because

of the nature of the network. Whereas the first is characterized as an undirected network because the relationship of co-authors is mutual (they have all participated in the creation of a specific object); the latter is characterized as a directed network since author A can cite another author B, but author B may not cite author A back. In both networks, the link established between nodes is as strong as the number of times an author cites/co-authors a work with another author. In directed networks, the in-degree (number of incoming links) increases whenever an author is cited by numerous other authors.

Studies in multiple disciplines have used academic journals to create citation networks of specific subjects or knowledge areas (e.g., marketing studies, [16]; sociology studies, [18]; Technology and other, Lewis [17]). In the design area, these methods are also starting to emerge with datasets based on journals (e.g., [15]). Although the number of academic journals in design research has expanded considerably in the last decades [19, 3], citation analysis made through those means can be partial because the existing indexed design journals in the Thomson Reuters Science Citation Index, Thomson Reuters Social Science Citation Index or in Scopus is yet limited [19].

This study aims to map PhD research in design adopting a PhD citation analysis approach. It uses Portuguese PhD research as a case of observation to explore the impact and reproducibility of PhD research in design.

17.3 Methodology

To map the trace and visualize the PhD research in design in Portugal, the PhD citations network was extracted in doctoral work undertaken in Portugal. The collection and selection of PhDs were based on a previous study developed by Costa et al. [12, 20] which already identify the design schools that provide the degree in the country, namely Aveiro university (UA), Faculty of Fine Arts of Porto University (FBAUP), Faculty of Fine Arts of Lisbon University (FBAUL); Faculty of Architecture of Lisbon (FAUL), Faculty of Architecture of Lisbon Technical University (UTL), European University (UEU), Creative University (IADE), and—more recently—Beira Interior University (UBI). The authors undertook a preliminary scan of the content of the doctorates collected, distinguishing between those that were more aligned with sociology, arts, history or others, from design. The present analysis takes into account the method used in Costa et al. [12] and considers design-focused PhDs as source material. PhDs which were more aligned with arts or other were not included as source material (see [12] for more details). National databases were consulted to check if any other PhDs were undertaken until the end of the PhD.

A total of 172 PhDs were included in the sample, going from 2005 to late 2019. Some doctorates were completed between 2001 and 2005 but were not considered in this study as they were classified as non-design focused by Costa et al. (2020a). Figures 17.1 and 17.2 provide the overall characterization of the source. Several schools have changed or been combined into others, i.e., UTL became FAUL in 2012;



Fig. 17.1 Characterization of the sample per year and school (172 PhDsource)



Fig. 17.2 Percentage of PhDsource per school

IADE and UEU were also combined. Our analysis, thus, identifies these schools as one (FAUL/UTL; UEU/IADE). In addition to the database provided by Costa et al. [20], the analysis was complemented with the latest information updates in the national governmental database RENATES until December 2019. The school, author, year of completion, and supervisor of the source (which we will name further on as “PhDsource”) were extracted to characterize the sample.

Two of the schools (UBI and IADE/UEU) were combined in the “other” category since they represent a small portion of the overall source (~2%). Most of the PhDsource is from FAUL/UTL (44%). The year 2019 also mainly presents input from this school. University repositories were consulted to check if any other design thesis was completed until the end of the year, but no other documents were found.

17.3.1 PhD Citation Extraction and Analysis

The author, year, country/school of the PhDs cited in the bibliography of the source dataset were extracted.

- (1) To explore the weight/influence of Portuguese doctorates, we distinguish the cited PhDs in two categories: “undertaken in Portugal” or “undertaken abroad”. Portuguese authors which undertook their PhDs abroad were categorized as “undertaken abroad”;
- (2) To understand the influence of Portuguese schools within the doctoral system—and thus, the roots/ground of the domestic design PhD research—we also extracted the name of all the Portuguese schools from which the PhDs cited were undertaken (design school or other);

- (3) A citation network analysis was conducted to examine the distribution of domestic PhDs focusing in particular in in-degree scores (number of times a PhD by other PhDs). In network analysis, the nodes and links are important to map and explore the connections. In our case, these connections constitute the overall domain of intellectual PhD references that domestic doctorate authors express. After the curation of nodes and edges, the visualization of the network was undertaken via Gephi: an open source software for graph and network analysis [14]. By using this method, we are able to gain some insight on some foundational aspects of doctoral research in design in Portugal and its reproducibility in the country.

17.4 Results

We counted 522 PhD citations appended in 172 doctoral theses in design submitted to the Portuguese National Design Schools which provide the degree (i.e., Aveiro University, Faculty of Fine Arts of Porto and Lisbon Universities, Faculty of Architecture of Lisbon, European University and Beira Interior University) between the period of 2005–2019. As seen in Fig. 17.3, the distribution of citations is proportional to the number of PhD theses considered as the source (PhDsource), with the exception of FAUL/UTL which presents a slightly inferior number of citations (–10%) in comparison to the number of PhDsource.

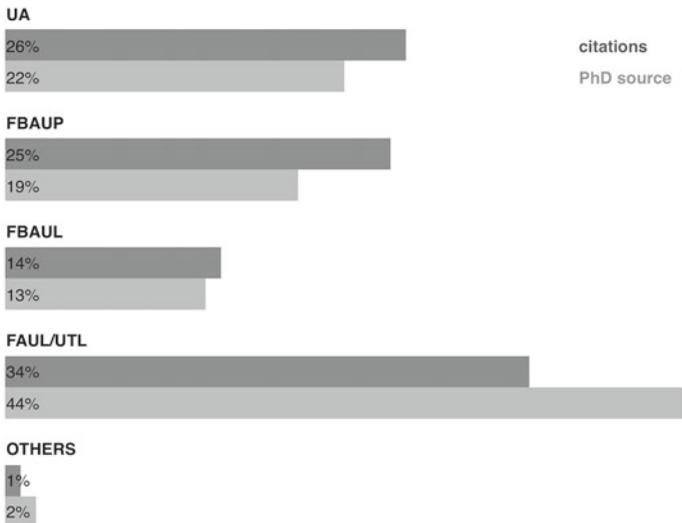


Fig. 17.3 Percentage of PhD citations versus percentage of PhDsource per design school

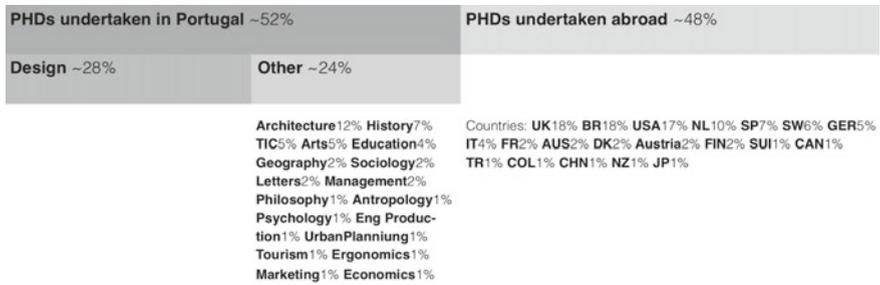


Fig. 17.4 Cited PhDs undertaken abroad and cited PhDs undertaken in Portugal

A total of 350 PhDs (or single authors) constitutes the universe of the doctorates cited, from which about half is undertaken in Portugal (~52%). The next countries with a higher citation index are the United Kingdom and Brazil (18%), the USA (17%) and the Netherlands (10%). Spain, Sweden, and Germany constitute 20% of the cited PhDs followed by Italy (4%). Other 13 countries are mentioned in the cited PhDs (Fig. 17.4). European countries constitute approximately 27% of the PhDs cited (besides Portugal). Design theses constitute at least 28% of all the citations and the remaining PhDs undertaken in Portugal are mostly related to architecture (12%), history (7%), communication and information technologies (5%), arts (5%), and education (4%). Other PhDs are focused on subjects such as marketing, economics, ergonomics, tourism, psychology, engineering production, letters, and urban planning (Fig. 17.4).

Results show that 32% (117) of the PhDsource do not cite any doctoral thesis in the bibliography; a quarter of the sample cites one to two PhDs; 19% cites 2–4 doctorates, 13% mention 5–6; and 11% cites 7 or more doctorates (Fig. 17.5). Only one thesis cites 23 PhD documents.

When looking at the distribution of PhDs cited “undertaken in Portugal”, an important percentage of the results points at multiple universities and polytechnic institutes mostly concentrated in the city of Lisbon (“other PT”). UL (Lisbon University), UTL (Technical University of Lisbon), and UNL (New University of Lisbon) are also represented in “others (PT)” since the PhDs were not undertaken in the Fine Arts nor the Faculty of Architecture (FBAUL and FAUL/UTL). Most of “other PT” doctorates are from Lisbon University. Minho University and Coimbra University



Fig. 17.5 PhDs cited in bibliography

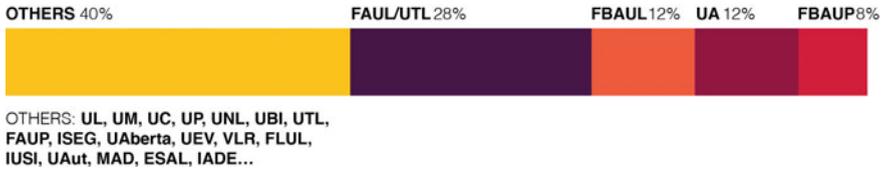


Fig. 17.6 School of origin of cited PhDs undertaken in Portugal (n182)

Table 17.1 PhD citations per school of PT schools including self-citations (total citations = 278)

Mentions>	UA (%)	FAUL/UTL (%)	FBAUL (%)	FBAUP (%)	OtherPTschool (%)
UA	34	13	19	4	30
FAUL/UTL	8	40	15	3	33
FBAUL	17	10	57	0	17
FBAUP	24	9	11	30	26

Table 17.2 PhD citations per school of PT schools excluding self-citations (total citations = 171)

Mentions>	UA (%)	FAUL/UTL (%)	FBAUL (%)	FBAUP (%)	OtherPTschool (%)
UA	0	19	29	6	45
FAUL/UTL	14	0	25	6	55
FBAUL	38	23	0	0	38
FBAUP	34	13	16	0	37

do also have an important weight (6 and 3%). The remaining schools (score: ~1%) are mentioned in one thesis (Fig. 17.6).

We analyzed the percentage of corresponding design-focused PhD cited “undertaken in Portugal” by schools to understand their global impact in doctoral domestic research. Table 17.1 shows domestic citation per school (source) of PT schools (including self-citations). Table 17.2 shows domestic citation excluding self-citations. UEU/IADE is not represented in these tables since the PhDsource do not cite PhDs undertaken in Portugal. UBI was also not represented since only one PhD in design was identified, and thus it is not representative.

The analysis shows that on average and considering only domestic research, the design schools mostly cite themselves, especially FAUL/UTL and FBAUL which account for more than 40% of self-citations. When looking at the same patterns, excluding self-citations (Table 17.2), the doctoral research impact changes abruptly indicating that most cited doctoral work is made in other non-design universities. FBAUL and UBI are an exception. FBAUL in particular shows a stronger connection to both UA and other non-design schools. When looking at citations of doctorates undertaken abroad, the main influencing references are European for all the schools (Table 17.3), especially the United Kingdom (Table 17.4).

Table 17.3 PhD citations per school of foreign schools/continent (total citations = 204)

Mentions>	North America (%)	South America (%)	Europe (%)	Asia (%)	Australia (%)
UA	24	5	71	0	0
FAUL/UTL	15	20	45	0	20
FBAUL	18	9	73	0	0
FBAUP	4	7	78	4	7

17.4.1 Network of the PhD Research in Design in Portugal

The map in Fig. 17.7 shows the connections established via cited PhDs in the bibliography of PhDsource. The nodes represent both cited authors as well as PhDsources. Directed links are drawn when an author/source mentions another PhD thesis. The size of the node is related to their in-degree value, that is, the number of incoming links or number of citations in PhDsource. The bigger nodes have received at least two citations from different sources in the dataset; thus, indicating some degree of semantic connection [15]. Figures 17.7a, b are colored according to the school in which the doctorate was undertaken. The layouts were created with Force Atlas.

The analysis shows that an important part of the PhDsource and PhD citations are isolated as most of citations are only mentioned once, in one thesis (Fig. 17.7b, one node, one/two links). Thus, few overlaps between the sources can be established via PhD citation. When analyzing the overlaps per design school, we conclude that the results are similar. There are only a few cases of cross-pollinating PhD works that connect the PhDsource (overlaps in-degree ≥ 2 , Fig. 17.7b). Table 17.5 indicates that the only school with some degree of cross-citations is FAUL/UTL. The case of FBAUL is also curious: despite the results presented in Table 17.1 (self-citation ~ 55%), the overlaps of the PhD citations are only a few (~2% in Table 17.5).

Second, there are numerous small clusters of one node pointing to other nodes. This indicates that a source mentions other PhDs (one or more) but is not continued nor connected to other doctorates via PhD-based bibliography. Since this is a directed network (authors mention other authors, but may not be mentioned back), this data shows that many research topics are not continued, evolved, nor connected to existing PhD research. When applying the in-degree filter of “more than 1 link” (mentioned in/mentioning more than one other node), only 56 nodes of the entire universe of PhDs (~11%) remain and 15 links remain visible (~4%). In Fig. 17.7b, we can visually identify the cross-pollinating nodes. From this network, most of the authors are still connected with a lot of isolated nodes with few links. The nodes with higher in-degree are mainly from the two national design schools. The rest of the map is abundant with “other PT” schools.

Table 17.4 PhD citations per school of European schools (total citations = 115)

Mentions>	SP (%)	FIN (5)	UK (%)	SW (%)	IT (%)	NL (%)	SUI (%)	GER (%)	DK (%)	AST (%)	TRK (%)
UA	11	0	33	22	11	15	4	0	0	4	0
FAUL/UTL	9	0	47	5	5	18	0	13	0	2%	0
FBAUL	11	0	44	0	0	22	11	0	0	11	0
FBAUP	13	0	25	17	0	13	0	13	17	0	4

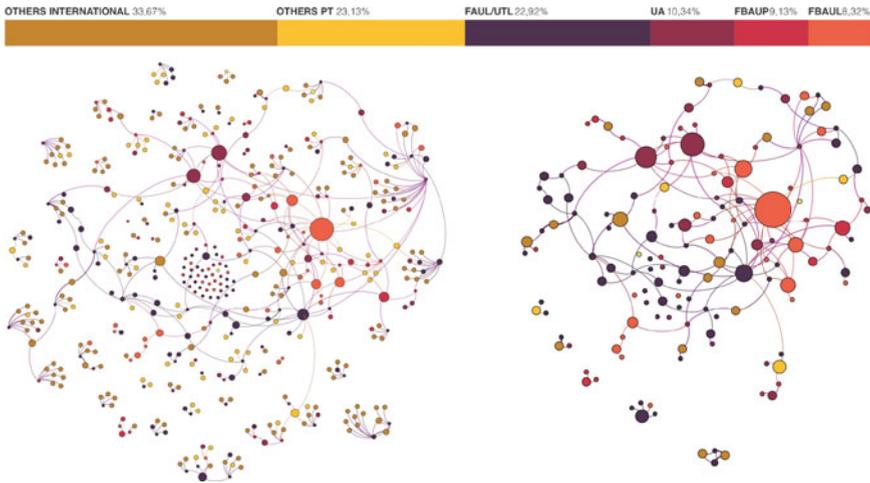


Fig. 17.7 **a** PhD cited in PhDSOURCE (color according to school), **b** PhD cited in PhDSOURCE with degree ≥ 2 (with at least two links)

Table 17.5 PhD citations overlaps per school

School	# PhDSOURCE	# nodes	# edges/links	Overlaps (in-degree ≥ 2)
FAUL/UTL	76	257	246	25 (33%)
UA	37	95	84	7 (5%)
FBAUP	32	94	84	9 (4%)
FBAUL	23	49	43	5 (2%)

17.5 Conclusions and Future Research

This study aims to trace, visualize, and interpret PhD research in design adopting a PhD citation analysis of domestic academic research. It applies a network-based approach in an empirical case to explore the common core connections between PhDs in design. From this process and delimitation of our case, we observe several aspects, namely:

- (1) PhD theses constitute a very small portion of the bibliographic work, with approximately 2% of representation in the entire dataset. PhDs in design constitute, more specifically, about half of this percentage of the source dataset. So far, we found no studies to compare this PhD percentage with other countries or other disciplines that could help us assess if it is common case. PhDs in design being such a small part of the bibliography of PhD research in design is also quite indicative that this type of output may not be relevant in academic design research—which is quite contradictory.

- (2) The connections are not evident through the PhD citations since very few PhDs cross-pollinate the doctoral research landscape. There are few overlaps observed between PhDs of the same research institute as well as between different national research institutes. This may indicate that doctoral research is still undertaken in an isolated way, despite having more researchers in this area.
- (3) An important part of the cited PhDs are non-design focused, with citations scattered in diverse fields of knowledge and schools. This may be due to the recent development of PhDs in design in the country (approximately two decades) which need more time to consolidate, or because of the inherently multidisciplinary and integrative nature of design and its increasing infusion in other areas. On the other hand, the vast number of single links and connections can also demonstrate the lack of coherence or narrowly drawn research questions in PhDs.
- (4) Finally, a third of the PhDs analyzed do not make any reference to previous PhDs (national or foreign). This observation is critical and raises important questions regarding the usefulness of PhD work—even within academia. Are there truly no connections which may be established with previous PhD work? Which type(s) of output(s)/production(s) are mostly used to support the development of a PhD in design? Moreover, given that Portugal has two decades of PhD research in the area—should aspiring design PhD students have access to a more structured research training? Do current research methods used and imported from other disciplines produce interesting and useful results for those who practice and investigate Design? Existing studies point at different directions when it comes to undertaking academic research at the PhD level (e.g., [21–25]). The questions raised, however, fall out of the scope of this research and require further inquiry. We encourage to further explore this issue in other countries, for comparison purposes.

This study has also some limitations which indicate directions for future research: First, (1) the paper only takes into account the PhD citations of PhD theses undertaken in Portugal. A more holistic view of the domestic doctorate system should account for all the research production cited by Portuguese authors to further understand the existing domestic PhD research system in design, including books, chapters, conference proceedings, or other. Second, (2) a more in-depth analysis of the cited research production of foreign doctorates could be useful to trace the core/origins and fundamental ideas of domestic doctoral research. Third, (3) although this is not the aim of this paper, the analysis of the collaboration networks is a core part of the ecosystem. Connecting the dots via doctorate citations—both inter and transnationally—could provide an overall map of the research collaborations between Portugal and the rest of the world; thus, providing a more robust and comprehensive view of the status quo of PhD design research in the country.

Doctoral research in Portugal is still evolving. This study, undertaken within DesignOBS project, contributes to advanced design research by presenting an application of a network-based observation approach to map the doctorate landscape,

based on empirical data, and draw some reflections regarding the status quo of domestic PhDs in design. At the international level, it provides important insights and raises questions regarding the traceability and usefulness of doctoral work within academia.

Acknowledgments This article is a result of the project Design Obs. Para um Observatório de Design em Portugal: Modelos, Instrumentos, Representação e Estratégias, (Towards a design Observatory in Portugal: models, instruments representation and strategies) supported by Lisbon Regional Operational Programme (LISBOA 2020) and the Competitiveness and Internationalisation Operational Programme (POCI-01-0145-FEDER-032445), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF) and FCT – Fundação para a Ciência e a Tecnologia (Foundation for Science and Technology).

References

1. Durling, D., Friedman, K.: Foundation for the future of doctoral education in design. La Clusaz (8–12 July), France (2000)
2. Branco, V., Branco, J., Aguiar, C., & Providência, F.: Universities and design research. In Durling, D., Friedman, K. (eds.) *La Clusaz—Foundations for the future of doctoral design education*, pp. 345–351. France (2000)
3. Gemser, G., de Bont, C.: Design-related and design-focused research: a study of publication patterns in design journals. *She Ji* **2**(1), 46–58 (2016). <https://doi.org/10.1016/j.sheji.2016.05.002>
4. Dorst, K.: Design practice and design research: finally together? In: *DRS2016: Future-Focused Thinking*, vol. 7, pp. 1–10 (2016). <https://doi.org/10.21606/drs.2016.212>
5. Margolin, V. (2000). Building a design research community. In: Pizzocaro, S., Arruda, A., De Moraes, D. (eds.) *Design Plus Research: Proceedings of the Politecnico di Milano Conference*, pp. 1–7. Retrieved from <https://design.osu.edu/carlson/id785/designcommunity.pdf>
6. Buchanan, R.: Design research and the new learning. *Design Issues* **17**(4), 3–23 (2001)
7. Margolin, V.: Design research: what is it? What is it for? In: *DRS2016: Future-Focused Thinking*, vol. 1, pp. 1–11. [https://doi.org/10.21606/drs.2016.9\(2016\)](https://doi.org/10.21606/drs.2016.9(2016))
8. Durling, D.: Discourses on research and the PhD in design. *Qual. Assur. Educ.* **10**(2), 79–85 (2002). <https://doi.org/10.1108/09684880210423564>
9. Friedman, K.: Reference, argument, and evidence. how good referencing and citation serve design research and professional design practice. Centre for Design Innovation, Swinburne University of Technology, Melbourne (Revised Reprint) (2015).
10. Borges, A., Silva, A.C., Modesto, A., Cunca, R., Costa, R.C., & Branco, V.: REDE#01: Reunião de Escolas de Design (2017). Retrieved from <https://hdl.handle.net/10773/24199>
11. Branco, V., Costa, R., Borges, A., Silva, A.C., Modesto, A., Cunca, R., & Costa, N. (2019). Towards a Portuguese design observatory: models, instruments, representation and strategies. Retrieved 7 Nov 2019, from <https://designobs.pt/>
12. Costa, N., Branco, V., Costa, R., Borges, A., Modesto, A., Silva, C., Cunca, R.: Towards a design observatory: the case of scholarly design research in Portugal. In: *Proceedings of the Design Society: DESIGN Conference*, vol. 1, pp. 827–836 (2020) <https://doi.org/https://doi.org/10.1017/dsd.2020.327>
13. Van Dalen, H.P., Henkens, K.: What makes a scientific article influential? The case of demographers. *Scientometrics* **50**(3), 455–482 (2001). <https://doi.org/10.1023/A:1010510831718>

14. Bastian, M., Heymann, S., Jacomy, M.: Gephi: An open source software for exploring and manipulating networks. In: BT—International AAAI Conference on Weblogs and Social. International AAAI Conference on Weblogs and Social Media, pp. 361–362 (2009)
15. Perna, S.: Design ResearchScape. a visual exploration of design research publications. *Design J.* **20**, S952–S963 (2017). <https://doi.org/10.1080/14606925.2017.1353040>
16. Baumgartner, H., Pieters, R.: The influence of marketing journals: a citation analysis of the discipline and its sub-areas. Discussion Paper, Dec 2014 (2000)
17. Lewis, J.: How transdisciplinary is design? An analysis using citation networks. *Design Issues* **36**(1), 30–44 (2020). https://doi.org/10.1162/desi_a_00573
18. Zafrunnisha, N.: Citations in the sociology doctoral dissertations: a quantitative analysis. *Int. J. Inf. Disseminat. Technol.* **2**(3), 212–218 (2012)
19. Gemser, G., De Bont, C., Hekkert, P., Friedman, K.: Quality perceptions of design journals: The design scholars’ perspective. *Des. Stud.* **33**(1), 4–23 (2012). <https://doi.org/10.1016/j.desstud.2011.09.001>
20. Costa, N., Branco, V., Costa, R., Borges, A., Cunca, R., Modesto, A., Silva, A.C.: Design doctorates undertaken in Portugal (database) (2020). <https://doi.org/10.5281/zenodo.3701614>.
21. Hilton, K.: The future of doctorates in design. In: DS 43: Proceedings of E and PDE 2007, the 9th International Conference on Engineering and Product Design Education, (September), pp. 197–202 (2007)
22. Melles, G.: Global perspectives on structured research training in doctorates of design—what do we value? *Des. Stud.* **30**(3), 255–271 (2009)
23. Melles, G., Wölfel, C.: Postgraduate design education in Germany: motivations, understandings and experiences of graduates and enrolled students in master’s and doctoral programmes. *Design J.* **17**(1), 115–135 (2014). <https://doi.org/10.2752/175630614X13787503070079>
24. Vaughan, L., Morrison, A.: Unpacking models, approaches and materialisations of the design PhD. *Stud. Mater. Think.* **11** (2014)
25. Vaughan, L., Morrison, A.: Form, fit and flair: considering the design doctorate. In: Complexity and diversity on the design PhD (May), pp. 14–17 (2013)
26. Curado, R.: Centro Português de Design vai ser extinto. 1–6. Retrieved from <https://www.dn.pt/artes/interior/centro-portugues-de-design-vai-ser-extinto-3248523.html> (2013)
27. Margolin, V.: Doctoral education in design: problems and prospects. *Design Issues* **26**(3), 70–78 (2010). https://doi.org/10.1162/DESI_a_00031