



MAPPING DOCTORAL EDUCATION AND SUPERVISION RESEARCH (2014-2024): INSIGHTS, TRENDS, AND TRAJECTORIES

Richard Tresidder	Sheffield Hallam University, Sheffield, UK	richard.tresidder@shu.ac.uk
Philip Coombes*	Sheffield Hallam University, Sheffield, UK	philip.coombes@shu.ac.uk
Nicola Palmer	Sheffield Hallam University, Sheffield, UK	n.palmer@shu.ac.uk
Laura Herriman	Sheffield Hallam University, Sheffield, UK	l.herriman@shu.ac.uk

* Corresponding author

ABSTRACT

Aim/Purpose	The conventional model of doctoral education, centered on conducting original research within an apprentice-supervisor framework, has evolved progressively toward alternative models, including shorter duration, the incorporation of a teaching component, a collaborative approach, and an emphasis on practice-based problem-solving. Using bibliometric methodologies, this paper aims to examine the intellectual landscape of doctoral education and supervision research over the past decade by identifying core literature, influential works, and key research trends, thereby supporting knowledge growth, innovation, and informed decision-making.
Background	Doctoral education and its related supervision have undergone multi-dimensional transformations over the past two decades, leading to increased scholarly interest and an expanding body of literature. Despite this growth, we still know little about the intellectual structure of research within the field. Furthermore, hitherto few bibliometric and meta-analytic reviews have been conducted, leaving the conceptual landscape of doctoral education and supervision research under-mapped and difficult to navigate.
Methodology	The study employs bibliometric methodologies, specifically citation and co-citation analyses, as well as bibliographic coupling, to rigorously and objectively map the intellectual structure of doctoral education and supervision research.

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Mapping Doctoral Education and Supervision Research

These methods provide quantitative insights into relationships between documents, authors, and journals, facilitating the identification of research clusters and networks.

Contribution	Drawing on a corpus of over 2,000 journal articles, the study analyses and maps the intellectual structure of the field, spotlighting influential researchers, institutions, and networks. The study identifies the areas where assimilation has taken place as a guide for future research. Further value is derived by identifying areas where there has been limited assimilation, and conclusions are drawn as to why such limited assimilation has occurred. Logical conclusions are then drawn regarding where future assimilation within doctoral education and supervision is needed, and how the field can make distinctive contributions to this literature. These contributions point to more effective collaboration, policymaking, and funding decisions within doctoral education and supervision research.
Findings	The interdisciplinary nature of doctoral education and supervision is evidenced by the distribution of journal articles, which suggest a broad range of research interests, with a significant concentration in the social sciences. The findings have implications for various stakeholders, including doctoral students, educators, and policymakers, who seek insights into past research and contribute to an understanding of applying bibliometric review methodologies to capture insights into the intellectual structure of research fields. The study identifies a rapidly growing body of literature, reflecting an increasing interest in research on doctoral education and supervision. Citation and co-citation analyses reveal key academic communities and emerging trends within doctoral education and supervision research.
Recommendations for Researchers	The paper represents a call to action, recommending that researchers continue to engage with rigorous bibliometric review methodologies to deepen their understanding of the field of doctoral education and supervision, moving beyond intellectual structure to intellectual content.
Impact on Society	The study enhances institutional decision-making in doctoral education and supervision, supporting the development of effective teaching and research environments. Mapping intellectual communities fosters collaboration and knowledge sharing, ultimately benefiting doctoral students, educators, and policymakers.
Future Research	While bibliometric analysis provides a broad overview, systematic reviews and meta-analyses could explore other diverse perspectives and methodologies, contributing to the intellectual development of the field. Despite the interdisciplinary nature of doctoral education, publications are predominantly found in the social sciences, which contrasts with the global dominance of STEM doctoral programs. Expanding research beyond social sciences is essential, as supervision practices vary across disciplines, with different approaches, actors, and dynamics shaping doctoral training. Recognizing these differences reinforces the need for tailored approaches – one size does not fit all.
Keywords	bibliometrics, doctoral education, doctoral studies, doctoral supervision research

INTRODUCTION

Despite being the pinnacle of academic training, doctoral education and supervision remain one of the least understood domains in higher education research. The conventional model of doctoral education, centered on original research within an apprentice-supervisor framework, has undergone a significant transformation. Emerging alternatives emphasize shorter program durations, integrated teaching components, collaborative structures, and practice-based, problem-solving orientations (Cardoso et al., 2020). These shifts reflect broader changes in the foundations, aims, methods, expertise, organization, and processes of doctoral education (Cardoso et al., 2022), contributing to its global expansion over the past two decades (Sarrico, 2022). As scholarly interest intensifies, the volume of publications in this field has surged, yet systematic syntheses remain scarce (see Liu et al., 2025; Wang et al., 2022, as notable exceptions). Few bibliometric or meta-analytic reviews have been conducted, leaving the conceptual landscape of doctoral education and its related supervision research under-mapped and difficult to navigate.

This paper addresses that gap by examining the intellectual landscape of doctoral education and supervision research over the past ten years. Using bibliometric methods – specifically citation and co-citation analyses – it identifies influential authors, thematic clusters, and evolving research trajectories. Bibliometrics applies statistical techniques to academic publishing (Campbell et al., 2005), enabling the detection of dominant contributors and patterns that inform policy and funding decisions. Citation-based approaches offer quantitative and complementary insights into relationships among documents, authors, and journals, revealing core literature and conceptual linkages (Garfield, 1972; Gingras, 2010; McCain, 1986; Osareh, 1996).

These methods do not assess academic quality or broader impact (Wilsdon et al., 2015), but they do illuminate how ideas and theories coalesce into intellectual communities (Lazzeretti et al., 2017). Despite the contributions of scholars such as Taylor (2012, 2014, 2023, 2025), the accelerating pace of publication poses challenges for both reviewers and researchers. As Karlstrøm (2024, p. 1) notes, “Efforts to manually summarize and synthesize knowledge within or across domains are increasingly running into constraints on resources or scope,” and there is “a challenge in the balance between not excluding too many possibly relevant studies and handling increasingly large corpora that result from document retrieval.” This study responds by offering a structured approach to mapping the field’s development. Two research questions guide this study:

RQ1: Who are the prominent authors in doctoral education and supervisory research, and what has been their impact to date?

RQ2: What topic areas present opportunities for further research and conceptual development?

Drawing on a corpus of over 2,000 journal articles, the study analyzes and maps the field’s intellectual structure, identifying leading scholars, institutions, and thematic networks. The study contributes to the literature by clarifying where integration has occurred and where conceptual fragmentation persists. It also proposes explanations for limited uptake in certain areas and outlines pathways for future synthesis. These insights support more effective collaboration, policymaking, and resource allocation in doctoral education and supervision research. Finally, the paper advocates for continued engagement with rigorous bibliometric methodologies to deepen understanding, both of the field’s structure and its evolving content.

The remainder of the paper is organized as follows. First, a review of systematic review methodologies is presented. Second, data collection and bibliometric techniques are outlined. Third, the results and discussion of longitudinal citation patterns are presented, followed by a discussion of methodological limitations. The paper concludes with implications and directions for future research. The methodological approach is presented next.

METHODOLOGY

BIBLIOMETRIC APPROACH

Research disciplines are characterized by patterns of communication between scholars. These patterns of communication manifest themselves in various ways, but foremost among these are citations from one author's work to another. The research methods employed in this paper are grounded in bibliometrics (Garfield, 1972; Zupic & Cater, 2015) and encompass various techniques for assessing academic literature through the statistical analysis of bibliographic data. Citation analysis is a commonly used method to support empirical investigations of the structure of various disciplines (Garfield, 1972). A citation is the acknowledgment that one article receives from another and generally implies a relationship between parts or the whole of the cited article and parts or the whole of the citing article (Smith, 1981). Citation analysis may focus on either or both articles and their authors (Osareh, 1996). The raw data that citation counts provide are appealing for analysis as they are "unobtrusive measures that do not require the co-operation of a respondent and do not themselves contaminate the response" (Smith, 1981, p. 84). The basic assumption underlying citation analysis is that authors cite their influences, so that citations act as surrogates for the influence of the cited work (Acedo & Casillas, 2005). Therefore, the total citations to a certain article, author, or journal offer an acceptable surrogate of that article's, author's, or journal's impact on a corresponding research field (Culnan, 1986).

Citation analysis is a way of measuring the relative importance or impact of an author, an article, or a journal publication. On the other hand, co-citation analysis can be used to reveal the intellectual structure of a research field (Small, 1973). The analysis assumes articles that are cited together are often similar thematically (Hjørland, 2013). In a co-citation network, two articles are co-cited by a third article when the latter simultaneously cites them (Small, 1973). In contrast, bibliographic coupling (Kessler, 1963; Weinberg, 1974) occurs when two articles reference a common third article in their reference lists. Co-citation analysis is forward-looking and more sensitive to current trends and emerging topics, while bibliographic coupling is retrospective and provides a clearer picture of established research areas. However, combining both methods can offer a more comprehensive view of a research field, capturing both established and emerging trends. The co-occurrence of keywords analysis can be used to enhance our understanding of the thematic clusters derived from co-citation analysis, as the themes formed through commonalities in articles tend to be relatively general (Chang et al., 2015). This analysis can help scholars interpret the meanings of each thematic cluster. Besides helping to uncover seminal publications and knowledge foundations, the analysis can be used to provide a preview of future research in the field (Donthu et al., 2021). A flow diagram illustrating the bibliometric approach adopted in this study is shown in Figure 1.

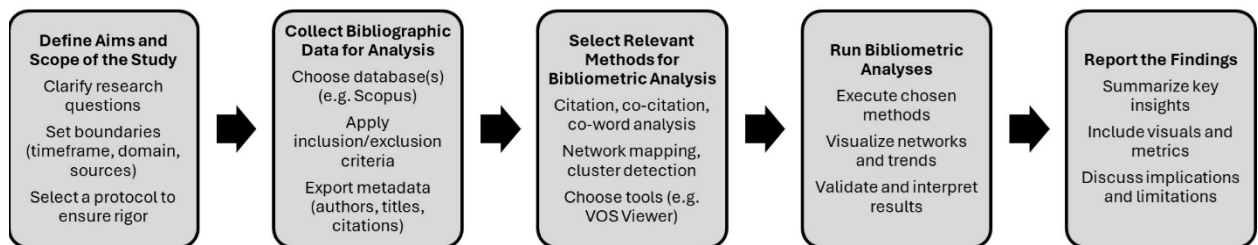


Figure 1. Bibliometric approach adopted for the study

It is also essential to acknowledge that, although the number of bibliometric review publications has increased recently, many still appear to be poorly reported (Orošnjak et al., 2024). Consequently, before carrying out our review and ensuring the necessary rigor, we adopted the Bibliometric Analysis Procedure and Best Practice Guidelines protocol (Donthu et al., 2021). The protocol's guidelines

consist of four sequential steps: Step 1: Define the aims and scope of the bibliometric study; Step 2: Select the techniques for bibliometric analysis; Step 3: Gather the data for bibliometric analysis; and Step 4: Conduct the bibliometric analysis and report findings.

Data collection

Step 1: With its origins in biomedical literature, systematic reviews are a complement to the traditional qualitative and interpretive approach to literature reviews utilizing quantitative tools and techniques and, through the identification of citation patterns, systematic reviews provide greater objectivity concerning the classification of publications related to a particular research field and are viewed as a “fundamental scientific activity” (Mulrow, 1994, p. 597). Their recent rise in popularity stems from the availability of free bibliometric software such as VOS Viewer, which assists in constructing and visualizing bibliometric networks, along with academic databases such as Elsevier’s Scopus, which support the acquisition and downloading of extensive bibliometric data (Donthu et al., 2021; van Eck & Waltman, 2010). By employing quantitative tools and techniques and identifying citation patterns, bibliometric reviews provide greater objectivity in classifying publications within a specific research field. Step 2: This paper utilized author citation analysis, author co-citation analysis, document co-citation analysis, and bibliographic coupling analysis. These analyses are further discussed later in this section. Step 3: To present a rigorous, systematic literature review, we created our first corpus by conducting an initial search using the Elsevier Scopus academic database from 2014 to 2024, inclusive.

Table 1 summarizes the methodological approach used to create the corpus. It is important to note that the search was limited to journal articles, as these are typically more accessible than other document types through databases and repositories, facilitating the collection of comprehensive or complete datasets.

Table 1. Summary of search outcomes for articles in the Scopus academic database

Criteria	Filters	Documents
Keyword search	doctoral education* OR doctoral program* OR PhD program* OR doctoral stud* OR doctoral train* OR doctoral research*	19,366
Restriction	Article title, abstract, keywords	
Restriction	Journal articles only	12,695
Subject area	All	12,695
Language	English	11,719
Restriction	doctoral education, doctoral students, doctoral studies, doctoral research, doctoral programs, PhD, doctoral supervision, PhD student, doctoral training, doctoral student, doctoral study, doctorate	2,709
Restriction	2014 to 2024	2,113
Document type	Journal articles	
Source type	Journals	796

In terms of searching and retrieving the literature for our corpus, after some experimentation with search strings, an initial search using Scopus was conducted with the search string: doctoral education* OR doctoral program* OR PhD program* OR doctoral stud* OR doctoral train* OR doctoral research* within the Article Title, Abstract, and Keywords of the publication. This search revealed 19,366 documents, including journal articles, books, conference papers, and other materials. The search was then refined to include only academic journal articles, which resulted in 12,695 documents. Following this, we refined the search to include only journal articles published in English,

thus avoiding any potential misinterpretation of the data later. This step revealed 11,719 documents published between 1953 (the earliest record we found) and 2024. Several interesting keywords emerged from the search, leading us to refine our search string further using: doctoral education* OR doctoral students* OR doctoral studies* OR doctoral research* OR doctoral program* OR PhD* OR doctoral supervision* OR PhD student* OR doctoral training* OR doctoral student* OR doctoral study* OR doctorate*. This focused search yielded 2,709 journal articles. Finally, to obtain our final corpus over the past ten years, we narrowed the results to include only those published between 2014 and 2024, resulting in 2,113 journal articles across 796 journal publications. Accordingly, this sample formed the final corpus for our study.

RESULTS AND DISCUSSION

Following Step 4, we present the results of the bibliometric analysis, including the author citation and co-citation analyses. Each individual analysis is followed by a discussion of the findings.

INTELLECTUAL STRUCTURE OF RESEARCH

Figure 2 presents a line chart illustrating the recent growth and upward trend of journal articles on doctoral education and supervision research between 2014 and 2024.

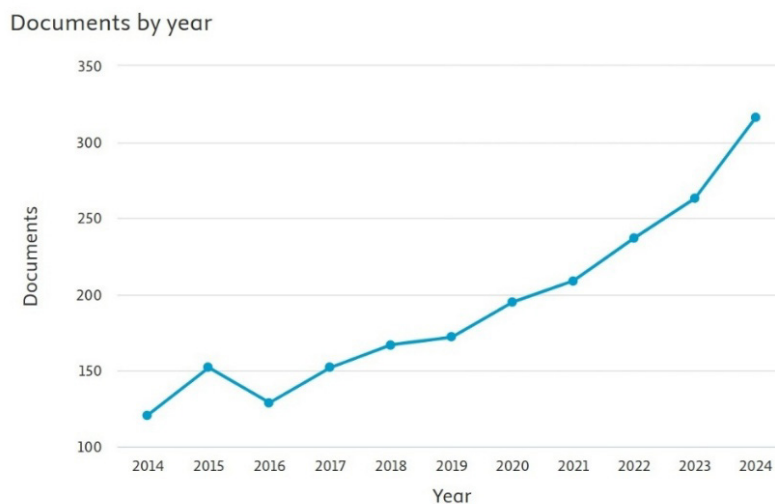


Figure 2. Growth of journal articles on doctoral education and supervision research between 2014 and 2024 (Source: Scopus)

A better understanding of a field's past enables researchers to assess its current structure and define avenues for research with greater sophistication (Culnan, 1986). From the line chart, there has been a clear upward trend in document publication over the past decade, suggesting a growing interest in this research topic. The dramatic rise since 2016 indicates a surge in research publications, which could reflect increased research activity, improved resources, or heightened interest in the subject matter. To continue our analysis, Figure 3 presents a pie chart illustrating the published articles in our corpus by subject area.

The interdisciplinary nature of the research topic is evidenced by the distribution of journal articles, which suggest a broad range of research interests, with a significant concentration in the Social Sciences. For instance, the Social Sciences category dominates, comprising over half ($n=53.9$) of the total documents. This indicates a strong focus on social sciences research within this corpus. Medicine, Psychology, Nursing, and Other fields have moderate representation, each contributing between ($n=5$) and ($n=9$) documents. The chart reflects diversity in disciplines such as Business, Management,

Arts and Humanities, and Computer Science, although each field accounts for a smaller percentage, under (n=5) each. Health Professions, Biochemistry, Genetics, and Engineering are the least represented, each contributing fewer than (n=3) to the total. Table 2 summarizes the top 25 journals that published the 2,113 articles between 2014 and 2024.

Documents by subject area

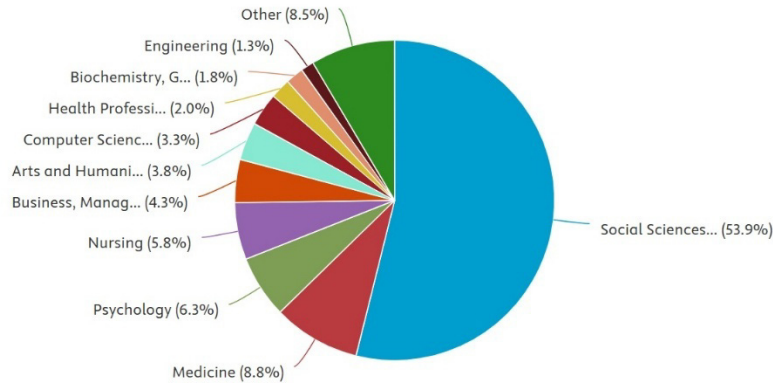


Figure 3. Journal articles publishing research by subject area between 2014 and 2024 (Source: Scopus)

Table 2. A summary of the top 25 journals publishing research between 2014 and 2024

Rank	Journal title	No. of articles	Weight %
1	International Journal of Doctoral Studies	100	4.7
2	Studies in Higher Education	74	3.5
3=	Higher Education Research and Development	65	3.1
3=	Studies in Graduate and Postdoctoral Education	65	3.1
5	Innovations in Education and Teaching International	57	2.7
6=	Higher Education	45	2.1
6=	Journal of Professional Nursing	45	2.1
8	Teaching in Higher Education	29	1.4
9	Journal of Further and Higher Education	24	1.1
10=	Journal of Teaching in Social Work	23	1.1
10=	Nursing Outlook	23	1.1
12=	Qualitative Report	20	0.9
12=	Studies in Continuing Education	20	0.9
14	PLOS One	19	0.9
15=	Education Sciences	17	0.8
15=	Journal of Social Work Education	17	0.8
15=	Quest	17	0.8
18	European Journal of Higher Education	16	0.8
19	BMC Medical Education	15	0.7

Rank	Journal title	No. of articles	Weight %
20=	Counsellor Education and Supervision	14	0.7
20=	Journal of Research on Leadership Education	14	0.7
22=	International Journal of Management Education	13	0.6
22=	Research on Social Work Practice	13	0.6
24=	Frontiers in Education	12	0.6
24=	Frontiers in Psychology	12	0.6
25	Journal of Higher Education	11	0.5
26-796	Others	1,333	63.1
	Totals	2,113	100

The top 25 journals collectively published (n=769) articles, which equate to 36.4% of the total articles published in our corpus. The remaining (n=771) journals contributed a significant 63.6% of the total articles, showing a broad distribution of contributions across many journals. The journal that published the most articles is the International Journal of Doctoral Studies with (n=100) articles, representing 4.7% of the total corpus. Studies in Higher Education is the second highest with (n=74) articles representing 3.5%, followed by Higher Education Research and Development and Studies in Graduate and Postdoctoral Education with (n=65) articles representing 3.1% of the corpus. While it is evident that some journals have a higher number of published articles, there is a wide range of contributions across many journals, illustrating a diverse publication landscape.

CITATION, CO-CITATION, BIBLIOGRAPHIC COUPLING, AND CO-WORD ANALYSES

The communication patterns among scholars characterize researchers, especially evident through citations from one author's work to another. Citation analysis is widely employed for conducting empirical studies on the intellectual structure of disciplines (Garfield, 1972). A citation acknowledges one article by another, indicating a relationship between the cited work and the citing article (Smith, 1981). Citation analysis may focus on articles and their authors. The assumption underpinning citation analysis is that authors cite their influences, making citations surrogates for the influence of the cited work (Acedo & Casillas, 2005). Total citations to a particular article, author, or journal provide a surrogate for that entity's impact on a research field (Culnan, 1986). Citation analysis measures the relative importance or impact of an author, article, or journal publication. Conversely, co-citation analysis (Small, 1973; White & Griffith, 1981) uncovers specialties within a field by identifying groups of authors or documents frequently cited in relevant literature. This method tracks pairs of papers cited together in source journal articles. Research clusters emerge when multiple documents cite the same pairs, and co-cited papers often share a common theme (van Eck & Waltman, 2010). Networks of co-cited documents are generated with the VOS Viewer application, providing a means to study the intellectual structure of a research field (Small, 1973). Bibliographic coupling (Kessler, 1963) identifies conceptual similarities by analyzing the references in which a document is cited. A document is deemed bibliographically coupled when it is referenced in two or more documents, aiding in the discovery of clusters based on content similarity (Zupic & Cater, 2015).

Prominent authors and their citation impact

Next, we conducted an author citation analysis using the VOS Viewer application to identify the most prominent authors in our corpus and their impact on citations. The relative importance of an author's article is measured by counting how many times other studies have cited it. The results of the analysis are illustrated on a map where authors are represented by labels and nodes (circles). The item's weight determines the size of the label and circle. The higher the weight, the larger the label

and circle. The color indicates the cluster to which it belongs. The lines between items represent edges (relationship links). The distance between the two authors indicates their relatedness regarding link strength (van Eck & Waltman, 2010). Figure 4 illustrates the results of the author citation analysis of prominent authors publishing doctoral education and supervision research between 2014 and 2024.

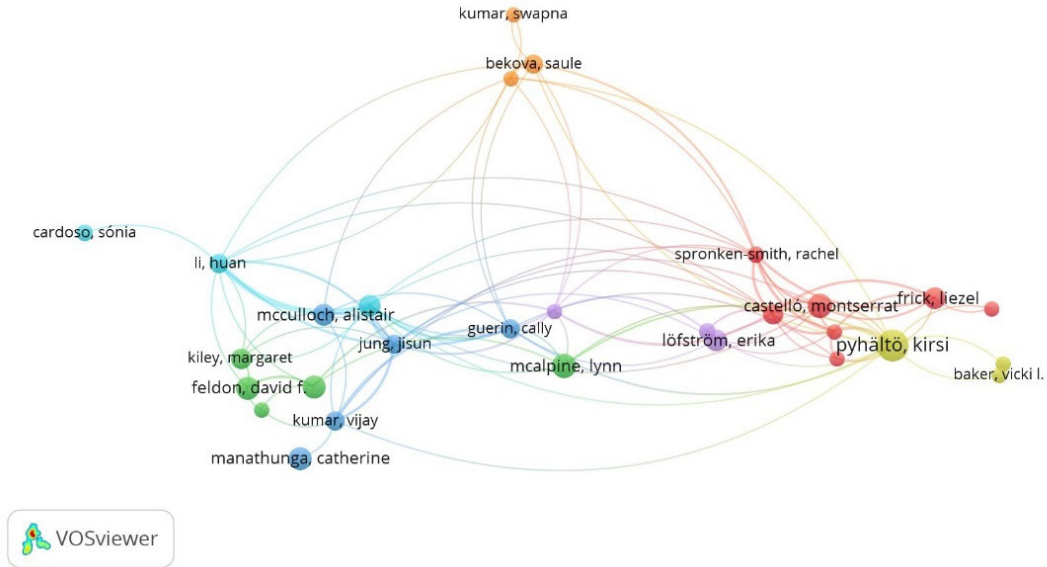


Figure 4. Citation analysis of prominent authors publishing doctoral education and supervision research between 2014 and 2024 (source: VOS Viewer)

The illustration identifies seven key clusters. The key metrics associated with this illustration are presented in Table 3.

Table 3. Citation impact

Cluster	Author	Total link strength	No. of articles	Total citations	Citation impact
1	Brodin, Eva M.	2	5	133	26.6
1	Castello, Montserrat	15	12	309	25.8
1	Spronken-Smith, Rachel	22	6	91	15.2
1	Peltonen, Jouni	6	5	66	13.2
1	Mason, Shannon	23	8	78	9.8
1	Frick, Liezel	12	9	70	7.8
1	Sakurai, Yusuke	20	5	23	4.6
2	Pretorius, Lynette	3	5	140	28.0
2	Feldon, David F.	7	11	301	27.4
2	McAlpine, Lynn	7	12	328	27.3
2	Roksa, Josipa	8	11	217	19.7
2	Kiley, Margaret	6	8	81	10.1
3	Guerin, Cally	19	7	237	33.9
3	Manathunga, Catherine	1	11	197	17.9
3	Kumar, Vijay	14	7	116	16.6

Cluster	Author	Total link strength	No. of articles	Total citations	Citation impact
3	Jung, Jisun	22	7	73	10.4
3	McCulloch, Alistair	8	10	80	8.0
4	Pyhalto, Kirsi	25	20	489	24.5
4	Baker, Vicki L.	1	5	118	23.6
4	Pifer, Meghan J.	1	5	118	23.6
5	Mantai, Lilia	15	5	239	47.8
5	Lofstrom, Erika	6	9	156	17.3
5	Burford, James	6	6	55	9.2
6	Horta, Hugo	36	9	198	22.0
6	Li, Huan	30	7	92	13.1
6	Cardoso, Sonia	1	6	60	10.0
7	Kumar, Swapna	2	5	101	20.2
7	Terentev, Evgeniy	15	5	90	18.0
7	Bekova, Saule	15	7	44	6.3

Each thematic cluster offers insight into the prominent authors and their citation impact. In Cluster 1 (red), Brodin leads with the highest citation impact ($n=26.6$). Her research focuses on scholarly and scientific development, particularly on building interdisciplinary research capacity in developing countries. Following her are Castello ($n=25.8$), Spronken-Smith ($n=15.2$), Peltonen ($n=13.2$), Mason ($n=9.8$), Frick ($n=7.8$), and Sakurai ($n=4.6$). In Cluster 2 (green), Pretorius has the highest citation impact ($n=28.0$), exploring academic language, literacy, research skills, and methodologies. Close behind are Feldon ($n=27.4$), McAlpine ($n=27.3$), Roksa ($n=19.7$), and Kiley ($n=10.1$). In Cluster 3 (blue), Guerin leads with a citation impact of ($n=33.9$), focusing on research writing, supervision practices, and doctoral education. Manathunga ($n=17.9$), Kumar ($n=16.6$), Jung ($n=10.4$), and McCulloch ($n=8.0$) follow. In Cluster 4 (yellow), Pyhalto has the highest citation impact ($n=24.5$), researching doctoral education, supervision, and well-being among PhD candidates. Vicki Baker ($n=23.6$) and Pifer ($n=23.6$) follow. In Cluster 5 (purple), Mantai has the highest impact ($n=47.8$), focusing on education, learning, student engagement, and doctoral education. Lofstrom ($n=17.3$) and Burford ($n=9.2$) follow. In Cluster 6 (cyan), Horta has the highest impact ($n=22.0$), studying PhD trajectories and knowledge production in higher education in Asia. Li ($n=13.1$) and Cardoso ($n=10.0$) follow. Finally, in Cluster 7 (orange), Kumar leads ($n=20.2$) with research on online education and supervision quality. Terentev ($n=18.0$) and Bekova ($n=6.3$) follow. In sum, Mantai, in Cluster 5, stands out with the highest individual citation impact, nearly doubling the next highest, for her work on student engagement and doctoral education. Other leading figures include Guerin (Cluster 3) on research writing and supervision, Pretorius (Cluster 2) on academic literacy, and Brodin (Cluster 1) on interdisciplinary capacity building. Cluster 2 has the highest average citation impact, indicating a particularly influential group, while Cluster 1 demonstrates the strongest collaborative ties. Collectively, the clusters map a diverse and impactful landscape of scholarship in doctoral education, academic development, and research practices.

Author co-citation analysis

Next, we deployed the VOS Viewer application to conduct an author co-citation analysis. Figure 5 illustrates the results of the author's co-citation analysis between 2014 and 2024. Again, the analysis results are illustrated on a map where authors are represented by labels and nodes (circles). The item's weight determines the size of the label and circle. The higher the weight, the larger the label and circle. The color indicates the cluster to which it belongs. The lines between items represent

edges (relationship links). The distance between the two authors indicates their relatedness regarding link strength (van Eck & Waltman, 2010).

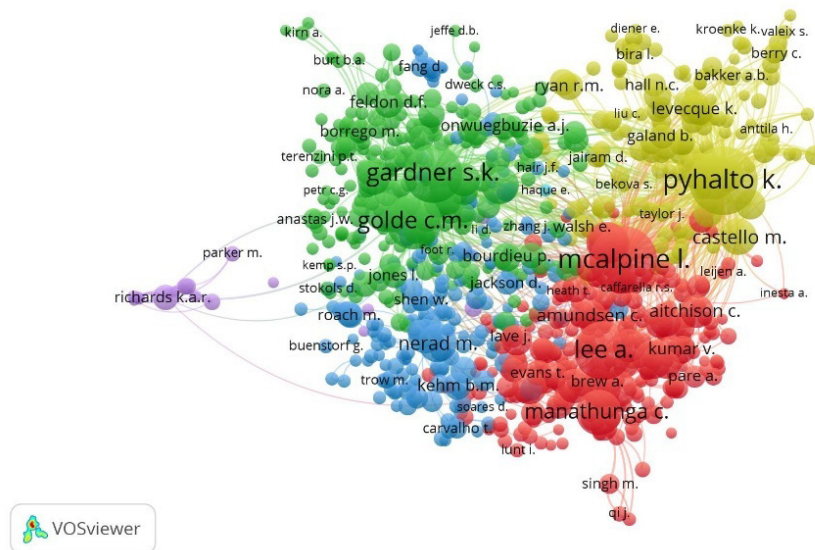


Figure 5. Co-citation analysis of authors publishing research between 2014 and 2024 (Source: VOS Viewer)

In our illustration, six key clusters can be identified. In Cluster 1 (red), McAlpine has the highest total link strength ($n=32,199$), indicating considerable influence within the cluster. Lee follows with ($n=19,502$). Link strength values range from ($n=32,199$) (highest) to ($n=246$) (lowest). A decline after the top contributors indicates a concentration of influence. Significant contributors like Manathunga ($n=10,002$), Wisker ($n=8,840$), and Boud ($n=8,588$) have lower strengths. Most individuals fall below 10,000, clustered around 1,000-5,000. The data suggests a hierarchical structure, with a few high link strengths and a long trail of lower strengths. In Cluster 2 (green), Gardner boasts the highest total link strength ($n=22,553$), indicating significant influence. Golde follows with ($n=19,003$). Strength values range from ($n=22,553$) (highest) to ($n=249$) (lowest). A decline in strength after the top contributors suggests an influential concentration among leading individuals. Austin ($n=8,905$), Lovitts ($n=8,640$), and Weidman ($n=7,428$) also contribute but have lower strengths.

Many individuals exhibit strengths below 10,000, clustered around 1,000-5,000, implying a hierarchical structure characterized by a few high and numerous lower strengths. In Cluster 3 (blue), Nerad has the highest total link strength ($n=8,313$), indicating significant influence. Horta follows closely with ($n=7,055$). Values range from ($n=8,313$) (highest) to ($n=84$) (lowest). A decline after the top contributors suggests an influential concentration among them. Contributors Kehm ($n=4,454$), Neumann ($n=4,024$), and Shen ($n=3,684$) also show substantial strengths. Many individuals have strengths below 5,000, with a considerable number clustered around 1,000-3,000, indicating a hierarchical structure with a few high and many lower strengths. In Cluster 4 (yellow), Pyhalto demonstrates the highest total link strength ($n=37,854$), indicating substantial influence. Lonka follows with ($n=16,140$). The strengths range from ($n=37,854$) (highest) to ($n=392$) (lowest). A decline after top contributors suggests a concentration of influence among a few. Contributors like Stubb ($n=11,464$), Castello ($n=10,114$), and Vekkaila ($n=9,573$) also contribute significantly but have lower strengths. Most individuals have strengths below 10,000, clustering around 1,000-5,000, revealing a hierarchical structure with a few high influences and many lower ones. In Cluster 5 (purple), Richards has the highest total link strength ($n=3,627$), indicating significant influence. Karen Smith follows with ($n=1,649$). The strengths range from ($n=3,627$) (highest) to ($n=387$) (lowest). A decline in strength

after Richards indicates a potential concentration. Contributors like Fletcher (n=1,529), Parker (n=1,305), and Templin (n=1,253) are also essential but exhibit lower strengths. Most individuals are below 1,000, clustered around 500-1,000, suggesting a hierarchical structure with one high strength and many lower ones. Finally, in Cluster 6 (cyan), Haque has a total link strength of (n=1,166), indicating their influence within the cluster. Analysis is limited, with only one individual listed, but Haque is the cluster’s primary contributor.

Document co-citation analysis

Next, we deepened our co-citation analysis and utilized the VOS Viewer application to perform a document co-citation analysis. This analysis is intended to uncover more specific patterns than author co-citation analysis, as cited references in document co-citation analysis convey more precise information than cited authors in author co-citation analysis. Figure 6 illustrates the results of the document co-citation analysis between 2014 and 2024, and the main metrics associated with this illustration are shown in Table 4.

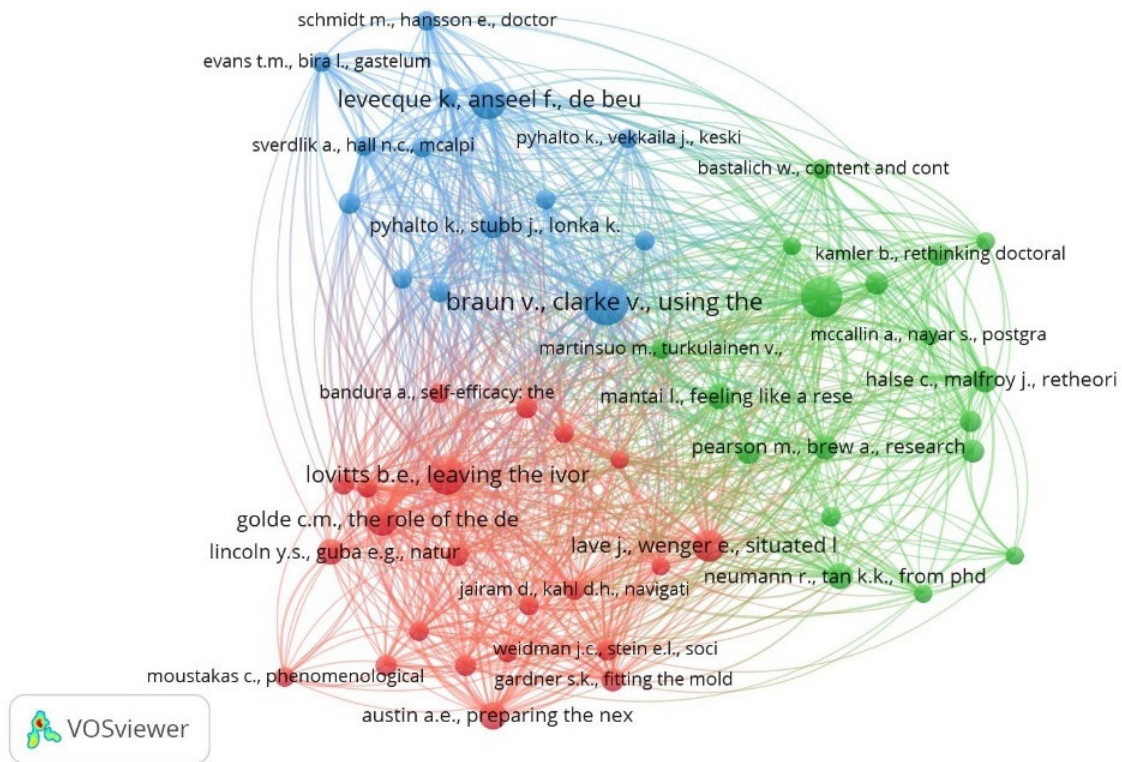


Figure 6. Document co-citation analysis between 2014 and 2024 (Source: VOS Viewer)

Table 4. Document co-citation articles

Cluster	Author(s) and title of cited article	Total link strength	Citations
1	Lovitts, B. E. (2001). <i>Leaving the ivory tower: The causes and consequences of departure from doctoral study.</i>	201	76
1	Golde, C. M. (2005). The role of the department and discipline in doctoral student attrition: Lessons from four departments. <i>The Journal of Higher Education</i> , 76(6), 669-700.	178	56

Cluster	Author(s) and title of cited article	Total link strength	Citations
1	Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. <i>The Journal of Higher Education</i> , 73(1), 94-122.	88	41
1	Gardner, S. K. (2010). Contrasting the socialization experiences of doctoral students in high- and low-completing departments: A qualitative analysis of disciplinary contexts at one institution. <i>The Journal of Higher Education</i> , 81(1), 61-81.	85	25
1	Jairam, D., & Kahl, D. H. (2012). Navigating the doctoral experience: The role of social support in successful degree completion. <i>International Journal of Doctoral Studies</i> , 7, 311-329.	81	22
1	Gardner, S. K. (2008). Fitting the mold of graduate school: A qualitative study of socialization in doctoral education. <i>Innovative Higher Education</i> , 33(2), 125-138.	78	28
1	McAlpine, L., & Amundsen, C. (2009). Identity and agency: Pleasures and collegiality among the challenges of the doctoral journey. <i>Studies in Continuing Education</i> , 31(2), 109-125.	75	22
1	McAlpine, L., Jazvac-Martek, M., & Hopwood, N. (2009). Doctoral student experience in education: Activities and difficulties influencing identity development. <i>International Journal for Researcher Development</i> , 1(1), 97-109.	72	20
1	Golde, C. M. (2000). Should I stay or should I go? Student descriptions of the doctoral attrition process. <i>The Review of Higher Education</i> , 23(2), 199-227.	70	21
1	Lave, J., & Wenger, E. (1991). <i>Situated learning: Legitimate peripheral participation</i> .	69	54
1	Weidman, J. C., & Stein, E. L. (2003). Socialization of doctoral students to academic norms. <i>Research in Higher Education</i> , 44(6), 641-656.	67	25
1	Weidman, J. C., Twale, D. J., & Stein, E. L. (2001). Socialization of graduate and professional students in higher education: A perilous passage?	67	26
1	Sweitzer, V. (2009). Towards a theory of doctoral student professional identity development: A developmental networks approach. <i>The Journal of Higher Education</i> , 80(1), 1-33.	65	21
1	Baker, V. L., & Pifer, M. J. (2011). The role of relationships in the transition from doctoral student to independent scholar. <i>Studies in Continuing Education</i> , 33(1), 5-17.	62	23
1	Spaulding, L. S., & Rockinson-Szapkiw, A. J. (2012). Hearing their voices: Factors doctoral candidates attribute to their persistence. <i>International Journal of Doctoral Studies</i> , 7, 199-219.	59	24
1	Tinto, V. (1993). Leaving college: Rethinking the causes and cures of student attrition.	58	29
1	Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry.	48	35
1	Saldana, J. (2016). The coding manual for qualitative researchers.	37	25
1	Cohen, J. (1988). Statistical power analysis for the behavioral sciences.	30	20
1	Charmaz, K. (2014). Constructing grounded theory.	27	22

Mapping Doctoral Education and Supervision Research

Cluster	Author(s) and title of cited article	Total link strength	Citations
1	Bandura, A. (1997). Self-efficacy: The exercise of control.	24	22
1	Moustakas, C. (1994). Phenomenological research methods.	19	22
2	Lee, A. (2008). How are doctoral students supervised? Concepts of doctoral research supervision. <i>Studies in Higher Education</i> , 33(3), 267-281.	208	87
2	Halse, C., & Malfroy, J. (2010). Rethorizing doctoral supervision as professional work. <i>Studies in Higher Education</i> , 35(1), 79-92.	96	37
2	Pearson, M., & Brew, A. (2002). Research training and supervision development. <i>Studies in Higher Education</i> , 27(2), 135-150.	95	32
2	Mantai, L. (2017). Feeling like a researcher: Experiences of early doctoral students in Australia. <i>Studies in Higher Education</i> , 42(4), 636-650.	81	35
2	Baker, V. L., & Lattuca, L. R. (2010). Developmental networks and learning: Toward an interdisciplinary perspective on identity development during doctoral study. <i>Studies in Higher Education</i> , 35(7), 807-827.	80	27
2	Martinsuo, M., & Turkulainen, V. (2011). Personal commitment, support and progress in doctoral studies. <i>Studies in Higher Education</i> , 36(1), 103-120.	67	21
2	Neumann, R., & Tan, K. K. (2011). From PhD to initial employment: The doctorate in a knowledge economy. <i>Studies in Higher Education</i> , 36(5), 601-614.	56	35
2	Lee, A. (2018). How can we develop supervisors for the modern doctorate? <i>Studies In Higher Education</i> , 43(5), 878-890.	55	27
2	Akerlind, G., & McAlpine, L. (2017). Supervising doctoral students: Variation in purpose and pedagogy. <i>Studies in Higher Education</i> , 42(9), 1686-1698.	53	20
2	Bastalich, W. (2017). Content and context in knowledge production: A critical review of doctoral supervision literature. <i>Studies in Higher Education</i> , 42(7), 1145-1157.	52	21
2	McCallin, A., & Nayar, S. (2012). Postgraduate research supervision: A critical review of current practice. <i>Teaching in Higher Education</i> , 17(1), 63-74.	48	20
2	Boud, D., & Lee, A. (2009). Changing practices of doctoral education.	45	28
2	Kamler, B. (2008). Rethinking doctoral publication practices: Writing from and beyond the thesis. <i>Studies in Higher Education</i> , 33(3), 283-294.	42	27
2	Park, C. (2005). New variant PhD: The changing nature of the doctorate in the UK. <i>Journal of Higher Education Policy and Management</i> , 27(2), 189-207.	41	26
2	Lee, A., & Kamler, B. (2008). Bringing pedagogy to doctoral publishing. <i>Teaching in Higher Education</i> , 13(5), 511-523.	37	20
2	Walker, G. E., Golde, C. M., Jones, L., Bueschel, A. C., & Hutchings, P. (2008). The formation of scholars: Rethinking doctoral education for the twenty-first century.	34	20

Cluster	Author(s) and title of cited article	Total link strength	Citations
2	Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. <i>Qualitative Research in Psychology</i> , 3, 77-101.	22	23
2	Park, C. (2007). Redefining the doctorate.	21	20
3	Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. <i>Qualitative Research in Psychology</i> , 3(2), 77-101.	193	109
3	Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gisle, L. (2017). Work organization and mental health problems in PhD students. <i>Research Policy</i> , 46(4), 868-879.	138	70
3	Pyhalto, K., Stubb, J., & Lonka, K. (2009). Developing scholarly communities as learning environments for doctoral students. <i>International Journal for Academic Development</i> , 14(3), 221-232.	90	33
3	McAlpine, L., & Norton, J. (2006). Reframing our approach to doctoral programs: An integrative framework for action and research. <i>Higher Education Research & Development</i> , 25(1), 3-17.	71	25
3	Sverdlik, A., Hall, N. C., McAlpine, L., & Hubbard, K. (2018). The PhD experience: A review of the factors influencing doctoral students' completion, achievement, and well-being. <i>International Journal of Doctoral Studies</i> , 13, 361-388.	67	22
3	Stubb, J., Pyhalto, K., & Lonka, K. (2011). Balancing between inspiration and exhaustion: PhD students' experienced socio-psychological well-being. <i>Studies in Continuing Education</i> , 33(1), 33-50.	64	20
3	Evans, T. M., Bira, L., Gastelum, J. B., Weiss, L. T., & Vanderford, N. L. (2018). Evidence for a mental health crisis in graduate education. <i>Nature Biotechnology</i> , 36(3), 282-284.	62	22
3	Litalien, D., & Guay, F. (2015). Dropout intentions in PhD studies: A comprehensive model based on interpersonal relationships and motivational resources. <i>Contemporary Educational Psychology</i> , 41, 218-231.	54	24
3	Schmidt, M., & Hansson, E. (2018). Doctoral students' well-being: A literature review. <i>International Journal of Qualitative Studies On Health and Well-Being</i> , 13(1).	54	21
3	Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. <i>Qualitative Research in Sport, Exercise and Health</i> , 11(4), 589-597.	53	21
3	Brown, L., & Watson, P. (2010). Understanding the experiences of female doctoral students. <i>Journal of Further and Higher Education</i> , 34(3), 385-404.	53	22
3	Pyhalto, K., Vekkaila, J., & Keskinen, J. (2015). Fit matters in the supervisory relationship: Doctoral students and supervisors perceptions about the supervisory activities. <i>Innovations in Education and Teaching International</i> , 52(1), 4-16.	52	21
3	Castello, M., Pardo, M., Sala-Bubare, A., & Sune-Soler, N. (2017). Why do students consider dropping out of doctoral degrees? Institutional and personal factors. <i>Higher Education</i> , 74(6), 1053-1068.	46	21
3	Holbrook, A., Shaw, K., Scevak, J., Bourke, S., Cantwell, R., & Budd, J. (2014). PhD candidate expectations: Exploring mismatch with experience. <i>International Journal of Doctoral Studies</i> , 9, 329-346.	46	21

Three significant clusters are evidenced in Table 4. This analysis highlights key themes in doctoral education, including mental health, socialization, supervision, support, and well-being. In Cluster 1 (red), studies on the experiences and socialization of doctoral students show high citation counts and link strength, underscoring their importance. Prominent articles include “Leaving the ivory tower: The causes and consequences of departure from doctoral study” by Lovitts (2001), which has a link strength of (n=201) and (n=76) citations; “The role of the department and discipline in doctoral student attrition” by Golde (2005); and “Preparing the next generation of faculty: Graduate school as socialization to the academic career” by Austin (2002). Cluster 2 (green) examines supervision and support in doctoral studies. Key works include “How are doctoral students supervised? concepts of doctoral research supervision” by Anne Lee (2008), with (n=208) link strength and (n=87) citations, alongside “Rethorizing doctoral supervision as professional work” by Halse and Malfroy (2010) and “Research training and supervision development” by Pearson and Brew (2002). Cluster 3 (blue) emphasizes doctoral students’ well-being and mental health, emphasizing supportive environments. The most cited article is “Using thematic analysis in psychology” by Braun and Clarke (2006), with (n=193) link strength and (n=109) citations, followed by “Work organization and mental health problems in PhD students” by Levecque et al. (2017) and “Developing scholarly communities as learning environments for doctoral students” by Pyhalto et al. (2009).

In sum, Cluster 1 (red) centers on the experiences and integration of doctoral students, with highly cited works by Lovitts, Golde, and Austin exploring attrition, departmental influence, and academic career preparation. Cluster 2 (green) focuses on supervision and institutional support, led by influential studies from Anne Lee, Halse and Malfroy, and Pearson and Brew, which reconceptualize supervisory roles and training. Cluster 3 (blue) highlights mental health and the importance of supportive environments, anchored by Braun and Clarke’s widely cited work on thematic analysis, alongside studies by Levecque and Pyhalto addressing psychological challenges and scholarly community development. However, it is important to recognize that mental health is rarely cited as a standalone construct. Instead, it’s disaggregated into terms like burnout, stress, emotional exhaustion, psychological safety, resilience, or well-being, which may have negatively impacted the results of this analysis. Together, these clusters underscore the multifaceted nature of doctoral education and supervision and the critical role of structural, relational, and emotional support in shaping doctoral trajectories.

Document bibliographic coupling

We conducted a bibliographic coupling analysis to supplement the previous co-citation evaluations. Figure 7 shows results from 2014 to 2024, where the size of circles indicates the citation volume of the documents, i.e., larger circles represent more citations. The lines between articles represent edges (relationship links), with strength values indicating referenced links.

Seven key clusters emerge. This first cluster provides insights into key factors influencing doctoral education and the academic discourse surrounding it. In Cluster 1 (red), the most cited papers include Hunter (2016) with (n=170) citations and a total link strength of (n=1,093) for a study entitled “Doctoral students’ emotional exhaustion and intentions to leave academia.” Next, Castello (2017) has (n=128) citations and a total link strength of (n=537), and Posselt (2018) has (n=97) citations and a total link strength of (n=587). The second cluster offers insights into the literature on doctoral supervision. In Cluster 2 (green), leading papers by citations include Bastalich (2017) with (n=111) citations and a total link strength of (n=626) with the paper, “Content and context in knowledge production: A critical review of doctoral supervision literature.” This is followed by Pyhalto (2015) with (n=111) citations and a total link strength of (n=574), and Odena and Burgess (2017) with (n=108) citations and a total link strength of (n=178). This third cluster presents research on the declining interest in academic careers and other aspects of doctoral education. In Cluster 3 (blue), the top paper by citations is by Roach and Sauermann (2017) with (n=138) citations and a total link strength of (n=367) with a study entitled “The declining interest in an academic career.” Bao et al. (2018) followed with (n=93) citations and a total link strength of (n=160), and Fan et al. (2019) with (n=91)

citations and a total link strength of (n=303). This fourth cluster provides insights into doctoral students' well-being and mental health challenges. In Cluster 4 (yellow), the most cited papers are Barry et al. (2018) with (n=140) citations and a total link strength of (n=370) featuring a study entitled "Psychological health of doctoral candidates, study-related challenges and perceived performance." Following this, Cornwall et al. (2019) has (n=85) citations and a total link strength of (n=512), while Waight and Giordano (2018) has (n=79) citations and a total link strength of (n=709). This fifth cluster offers insights into diverse aspects of doctoral education, including challenges, support mechanisms, and identity development. In Cluster 5 (purple), the most cited paper is Mantai (2017), with (n=131) citations and a total link strength of (n=797) titled "Feeling like a researcher: Experiences of early doctoral students in Australia." This is followed by Devos et al. (2017) with (n=121) citations and a total link strength of (n=1,203) and by Janta et al. (2014) with (n=108) citations and a total link strength of (n=599). The sixth cluster provides valuable insights into doctoral nursing programs, emphasizing mentoring, strategies for enhancing the PhD pipeline, and variations in pathways to a PhD in nursing. In Cluster 6 (cyan), the top studies are Anderson et al. (2019) with (n=46) citations and a total link strength of (n=30) with a study entitled "Mentoring students engaging in scholarly projects and dissertations in doctoral nursing programs." This is followed by Stanfill et al. (2019) with (n=36) citations and a total link strength of (n=101) and by Nehls et al. (2016) with (n=29) and a total link strength of (n=132). Finally, the seventh cluster comprises a paper highlighting research students' expectations and induction. In Cluster 7 (orange), the top paper by citations is by McCulloch and Bastalich (2023) with (n=6) citations and a total link strength of (n=327) with a study entitled "Commencing research students' expectations and the design of doctoral induction: Introducing inflections of collaboration and pleasure."

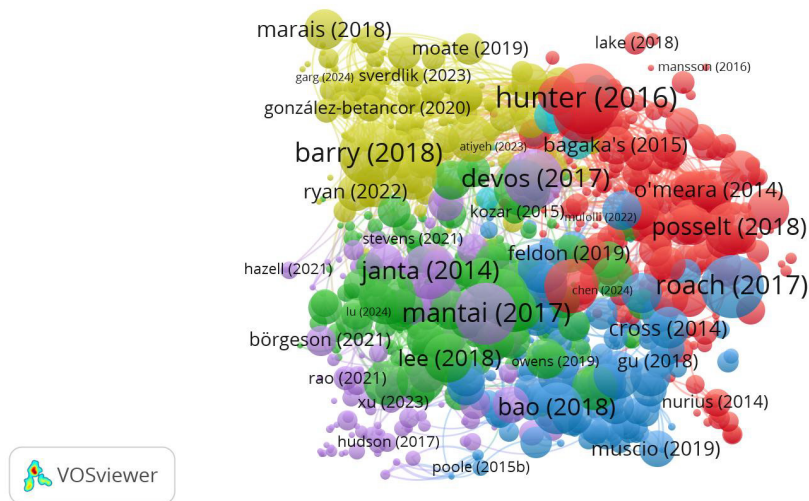


Figure 7. Document bibliographic coupling analysis between 2014 and 2024 (Source: VOS Viewer)

Co-occurrence of author keywords analysis

Next, we conducted a co-occurrence analysis of author keywords to enhance our analysis further and identify key topics in our corpus. The intention here is to generate a more detailed understanding of the components of knowledge and the structure of doctoral education and supervision research. This analysis assumes that keywords that frequently appear together (i.e., co-occur) in the same articles are related. We identified 276 unique author keywords within our corpus. The keyword 'supervisor' appeared prominent in the analysis, both in frequency and link strength, which underscores the centrality of supervisory relationships in doctoral education and discourse. Therefore, to further investigate the topic of doctoral supervision, we refined our keyword search in Scopus to include only journal

articles that contained the keywords doctor* AND supervis* in the article title, abstract, and keywords of the publication. After creating this second corpus, we conducted a frequency count of all author keywords in our sample. Out of 29 unique keywords, the keyword ‘doctoral supervision’ had the highest occurrences (n=129). However, other variations of the keyword appeared throughout the analysis. The keyword ‘supervision’ had (n=29) occurrences, ‘doctoral supervisors’ had (n=10), ‘PhD supervision’ had (n=9), ‘supervisors’ had (n=9), ‘doctoral supervisor’ had (n=8), ‘research supervision’ had (n=7), ‘supervisor development’ had (n=7), ‘co-supervision’ had (n=6), and finally ‘supervisory relationship’ had (n=5) occurrences. Figure 8 presents an illustration showing the results of the co-occurrence analysis of all keywords between 2014 and 2024.

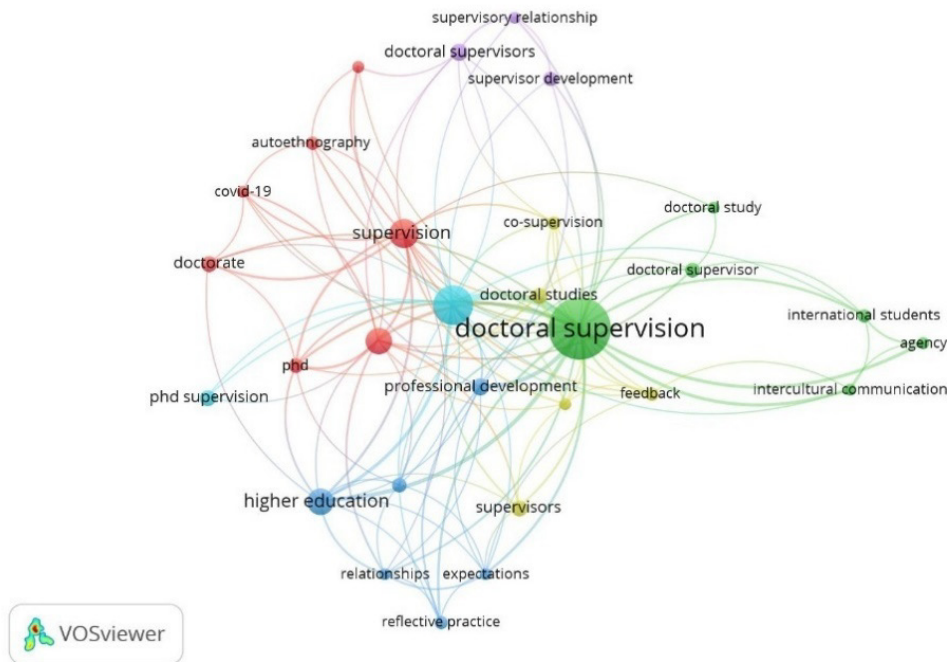


Figure 8. Co-occurrence of author keywords analysis between 2014 and 2024 (source: VOS Viewer)

Six key clusters can be identified. In Cluster 1 (red), the supervision and doctoral writing theme appears significant. The keywords with the highest link strength are ‘supervision’ (n=34), ‘doctoral students’ (n=26), and ‘PhD’ (n=16). In Cluster 2 (green), the doctoral supervision and communication theme is evident. The keyword with the highest link strength is ‘doctoral supervision’ (n=94). In Cluster 3 (blue), the higher education and professional development theme appears notable. The highest link strength keywords are: ‘higher education’ (n=27), ‘professional development’ (n=18), ‘expectations’ (n=12), and ‘relationships’ (n=12). In Cluster 4 (yellow), the doctoral studies and feedback themes are distinct. The strongest keywords are ‘doctoral studies’ (n=11), ‘feedback’ (n=11), and ‘co-supervision’ (n=10). In Cluster 5 (purple), the supervisory relationships and development theme emerge. The highest link strength keywords include: ‘doctoral supervisors’ (n=8), ‘supervisory relationship’ (n=6), and ‘supervisor development’ (n=5). Finally, in Cluster 6 (cyan), the theme of doctoral education and PhD supervision emerges. The keywords with the highest strength are ‘doctoral education’ (n=57) and ‘PhD supervision’ (n=3).

The extent to which these keywords co-occur is intriguing, particularly regarding developments in doctoral supervision. Internationally, supervision has been a central component of transforming doctoral education (Cardoso et al., 2022). Indeed, the professionalization of doctoral supervision has recently led to significant sector-wide initiatives. For instance, the UK Council for Graduate Education

(UKCGE) collaborated with Professor Stan Taylor (2019) to develop and promote a Good Supervisory Practice Framework (GSPF), establishing expectations for all doctoral supervisors and supporting supervisor development. This framework identifies several core themes, which serve as the basis for reflection (and literature engagement) when applying for UK research supervisor recognition: recruitment and selection; supervisory relationships with candidates; supervisory relationships with co-supervisors; supporting candidates' research projects; encouraging candidates to write and providing appropriate feedback; keeping research on track and monitoring progress; supporting candidates' personal, professional, and career development; assisting candidates through completion and final examination; and helping candidates disseminate their research (Jairam & Kahl, 2012; Sverdlik et al., 2018). The UK Council for Graduate Education (2025, p. 1) asserts, "The framework is informed by the extensive body of academic research into research supervision and has been validated during a pilot study involving research supervisors across the UK." While the emphasis placed on supervision through the co-occurrence of keyword analysis underscores its vital role in doctoral education, we do not observe clear evidence addressing the urgent needs of doctoral supervisors, as highlighted by national surveys. Data concerning national surveys of research supervisors in France and the UK reveals ongoing concerns about the growing complexity of supervision associated with candidate diversity, intercultural communication, financial stress experienced by candidates, the navigation of identity (Inouye & McAlpine, 2019) and workload challenges, supervisor confidence and well-being, and a perceived lack of institutional recognition (Gower & Clegg, 2021; Gower et al., 2024; Pommier et al., 2022).

Limitations of the bibliometric analysis

Compared to qualitative reviews, bibliometric tools like Scopus provide a particular view of the bibliographic universe, which may not cover all relevant publications, particularly those in non-English languages or from less-represented disciplines. Whilst bibliometric analysis can distinguish between what is cited and what is not, it cannot necessarily distinguish what is of high quality. For instance, articles can be cited frequently for negative reasons, and some high-quality research may not receive many citations. Different academic disciplines also exhibit varying publication and citation practices; for instance, some place greater reliance on books and book chapters, which are often excluded from academic databases. Furthermore, it is essential to recognize that the bibliometric methodologies deployed in this study have certain limitations due to the methodological constraints inherent in the research designs and the corpus. The first limitation pertains to the nature of database searches for published journal articles. As Scopus is regularly updated with new publications, our corpus reflects only a 'snapshot' during the data collection period. The second limitation involves the search strings employed. Different keyword search strings could have produced varying results during the database searches. The third limitation concerns the author citation analysis of our corpus, which is retrospective and includes citation data only after a certain period has elapsed. Author co-citation analysis also relies on simple co-citation counting, which does not take into account the content of the citations (Jeong et al., 2014). Finally, bibliometric data can be manipulated through self-citations, citation cartels, and honorary citations, which may potentially inflate bibliometric measures. Despite these limitations, the findings from the bibliometric analyses presented in this paper will be highly valuable for doctoral students, educators, and policymakers seeking insights into prior research on doctoral education and supervision.

CONCLUSIONS AND IMPLICATIONS

The aim of this paper was to explore the intellectual structure of doctoral education and supervision research over the past decade. In doing so, it does not make any judgments on the quality of research or its impact; it reports on systematic data mining of a corpus. The decision to focus on a corpus limited to journal articles was linked to the risk of incomplete Scopus data regarding other types of output, such as conference papers, book chapters, and monographs. We took the view that journal articles represent the cutting edge of research. Therefore, to address the first research question: Who are

the prominent authors in doctoral education and supervisory research, and what has been their impact to date? This paper has examined the intellectual structure of doctoral education and supervision research through a comprehensive bibliometric approach, including citation analysis, co-citation mapping, and bibliographic coupling. By tracing literature trends from 2014 to 2024, the study reveals how a relatively small group of influential authors has come to dominate the field's intellectual landscape. While citation analysis assumes that authors cite their intellectual influences, the findings suggest that this influence is not evenly distributed. Instead, there is a notable concentration of ideas and perspectives, which risks narrowing the field's epistemic boundaries and limiting its capacity for innovation, diversity, and creative disruption. Such intellectual consolidation raises important questions about citation bias and the mechanisms through which certain voices are amplified while others remain marginalized. The tendency to reference established authorities may inadvertently suppress emerging scholarship and novel approaches to supervision. This calls for a more critical engagement with the politics of citation and a deeper inquiry into whose voices are heard – and whose are not – in shaping doctoral education discourse.

At the same time, the paper highlights promising developments that may counteract these trends. Recognition programs such as SEDA's Recognized Supervisor award and the UKCGE's Full and Associate Supervisor Recognition schemes encourage practitioners to engage with pedagogic literature, often for the first time. These initiatives, along with networks like the UKCGE Research Supervisors' Network and the Canadian Association for Graduate Studies' National Community of Practice, provide accessible platforms for knowledge exchange and professional development. They also serve as conduits for expanding the reach of underutilized scholarship and fostering a more inclusive supervisory culture. Drawing on a corpus of over 2,000 journal articles, the study contributes to the literature by identifying areas of assimilation, offering insights into why certain domains remain under-integrated. These findings provide a roadmap for future research, suggesting where intellectual synthesis is most needed and how the field might make distinctive contributions to broader educational and policy debates. By mapping intellectual communities and tracing citation patterns, the paper supports more informed institutional decision-making and enhances the development of effective supervision practices. Ultimately, this research represents a call to action for scholars to continue engaging with bibliometric methodologies – not only to chart the structure of the field but also to interrogate its intellectual content. In doing so, the doctoral education and supervision community can foster greater collaboration, support more equitable knowledge production, and contribute to a more dynamic and responsive research environment that benefits doctoral students, educators, and policy-makers alike (for example, see Clegg et al., 2025).

FUTURE RESEARCH DIRECTIONS

To address the second research question: What topic areas present opportunities for further research and conceptual development? There are opportunities to examine the geographic distribution of research outputs, considering global geography patterns in doctoral education as well as socio-political norms and practices within academic publishing. There is value in following up bibliometric analyses with thematic analyses to deepen the understanding of the doctoral education field, moving beyond intellectual structure to intellectual content. This will assist in identifying precise topic areas for further research and aligns with Karlström's (2024, p. 1) argument that “the goal of a systematic review is to provide accurate, insightful, and actionable analysis for policymakers. The tools employed, whether manual or computational, should always serve this primary objective.” This paper has illustrated that analyzing author keyword co-occurrence as part of bibliometric analysis can help transition from a broad to a narrower focus. Focusing on the supervision cluster provides an opportunity to understand how it serves as a starting point for refining focus and identifying essential implications for doctoral education policy and practice. Bibliometric analysis can provide a valuable overview and help navigate large volumes of literature over time; however, these reviews need to be supplemented by other systematic reviews and meta-analyses investigating the diversity of perspectives in doctoral education. Building on the work of González-Ocampo and Badia (2019), there is potential to give

more consideration to the methods and approaches utilized across studies of doctoral supervision and doctoral education in general. The way the authors examine the topic areas is a crucial aspect of the intellectual development of the field of doctoral education. Despite the interdisciplinary nature of doctoral education, demonstrated by the variety of journal articles indicating a wide array of disciplinary research interests, there is a notable concentration of publications in the Social Sciences. This contrasts with a predominance of Science, Technology, Engineering, and Mathematics (STEM) doctoral programs globally (OECD, 2021). Generating, sharing, and examining opportunities for further research beyond the Social Sciences is essential. This is vital because different subject areas employ varying practices in supervision, bringing distinct approaches, actors, and dynamics to the supervision process. We can assert with some confidence that one size does not fit all.

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AUTHORS



Dr Richard Tresidder is an Associate Professor of Marketing at Sheffield Hallam University. During his long academic career, Richard has validated PhDs and Professional Doctorates and managed doctoral programs. Richard is a UKCGE Recognized Research Supervisor and has developed and managed development programs for doctoral supervisors, delivering these both in the UK and internationally.



Dr Philip Coombes is a Senior Lecturer in Marketing at Sheffield Hallam University. His research interests include conducting systematic review methodologies of various types and approaches, including bibliometric and meta-analysis reviews of literature.



Dr. Nicola Palmer is Head of Doctoral Training at Sheffield Hallam University and leads the pedagogy and scholarship strand of the Research England funded Next Generation Research SuperVision Project (RSVP). She is an active research supervisor who has rich experience in examining and supervising to completion over 30 doctoral candidates across different types of doctoral awards in diverse institutional contexts.



Laura Herriman is a Senior Administrator at Sheffield Hallam University. Laura is currently working on the Next Generation Research SuperVision Project (RSVP), coordinating work package activities, training, and events in the Doctoral School. Laura's background is in events and marketing management, having over a decade of experience managing large-scale events, projects, and executing marketing plans.