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REVIEW ARTICLE

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Postdoctoral nursing researcher career: A scoping review of required competences

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Abstract

Aim: The aim of this review was to identify and summarize the required competences of nursing PhD students and postdoctoral researchers to pursue a successful researcher career and to compare these competences with the existing competence frameworks.

Design: Scoping review.

Methods: PubMed, CINAHL, SocIndex, PsycInfo, Eric, EMBASE, Academic Search Premier and Scopus databases were searched from January 1990–December 2018. The guidelines of PRISMA Extension for Scoping Reviews and the scoping review framework by Arksey and O'Malley (2005, International Journal of Social Research Methodology, 8, 19) were applied.

Results: Forty-four studies were reviewed comprising 15 competence domains. Competences corroborated the competences defined in the competence frameworks. However, the qualitative and descriptive research designs rendered a modest level of evidence and generalizability.

KEYWORDS
competences, multi-scientific approach, PhD students, postdoctoral researchers, scoping review

1 | INTRODUCTION

Competent researchers are fundamental to the development of any scientific discipline. Researchers develop their basic competence through PhD and postdoctoral (henceforth doctoral) education, which aims to produce highly qualified researchers who can offer solutions to existing and future problems thus adding to the development of societies worldwide. Consequently, researchers are expected not only to continue their careers in universities but also in the worlds of business, industry and other areas outside the academia (Academy of Finland, 2017; Bogle, Dron, Eggermont, & Henten, 2011; ESF, 2009; EU, 2011; EUA, 2018a, 2018b; Vitae, 2010).

Also, nurse researchers are important in contributing to the development of nursing science and developing and translating evidence into clinical practice, both in their own societies and globally. However, scientific nursing community needs supportive measures to improve and to strengthen its doctoral researchers' scientific career development tracks (Hafsteinsdóttir et al., 2019; Hafsteinsdóttir, Zwaag, & Schuurmans, 2017). In an attempt to address this issue

*https://www.nurselead.org/

and to provide opportunities for nurse researchers, The Nursing Leadership Educational Program for Doctoral Nursing Students and Postdoctoral Nurses (Nurse Lead) was launched as the first of such measures. It was carried out in collaboration between universities in six European countries aiming to direct doctoral researchers into an academic career by expanding their educational, research and leadership competences (Nurse Lead, 2018).

In pursuing a research career, PhD degree is the first step continuing as a postdoctoral period. For supporting the research career, the European Union has prepared a reference tool to make research career structures more comparable across employment sectors and countries. The European Framework for Research Careers has introduced four broad career profiles from a PhD student to a leading researcher applying to all researchers, offering a bridge across national or sectoral boundaries (Academy of Finland, 2016; EU, 2011).

To succeed in their contemporary role, doctoral researchers are expected to have several competences. Defining competence has been found to be a matter of debate; however, immersing in this debate is beyond the scope of this review. Here, competence is defined as 'an acquired personal skill that is demonstrated in one's ability to provide a consistently adequate or high level of performance in a specific job function' (National Postdoctoral Association [NPA]). Although several frameworks of required competencies exist, doctoral researchers' competences have also been the focus of several studies, many of them dealing with doctoral researchers' own perceptions of essential competences (Anttila, Lindblom-Ylänne, Lonka, & Pyhältö, 2015; Durrette, Fournier, & Lafon, 2016; Mowbray & Halse, 2010). A comprehensive, evidence-based view based on multiple data sources would add and corroborate knowledge of the competences needed in the beginning of a research career and beyond.

This scoping review aims to present competences required of doctoral researches retrieved from studies using systematic data search procedures from relevant databases covering the years 1990–2018. Furthermore, existing competence frameworks will be analysed and compared with competences retrieved from the reviewed studies.

1.1 | Existing competence frameworks

The challenges of contemporary doctoral career development have led several international bodies and organizations to develop competence frameworks to provide future researchers with an open, transparent and compatible training system to undertake research or to participate in the labour market in Europe or globally (EU, 2017) entailing the notion that doctoral training is seen more as a process than as a one-time product (Mowbray & Halse, 2010; Park, 2005; Table 1).

The Bologna process was initiated with the Bologna Declaration in June 1999 as a joint declaration of the European Ministers of Education and as an intergovernmental cooperation of 48 European countries. The primary objective was to establish the European Higher Education Area (EHEA, 2010/www.ehea.info) to ensure that higher education systems across Europe are compatible and that students, researchers and academics can collaborate, study or work abroad more easily making Europe the most competitive and dynamic knowledge-based economy in the world (EHEA, 2010; EU, 2000). The following documents support this goal.

In 2005, the European Commission adopted the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (https://euraxess.ec.europa.eu/jobs/charter; accessed 8 August 2019). These two documents are key elements in the EU's policy to boost research careers. The European Charter for Researchers (2005) provides general principles specifying the roles, responsibilities and entitlements of researchers, their employers and funders aiming to ensure that the nature of the relationship between them is conducive to successful performance in generating, transferring, sharing and disseminating knowledge and technological development and to the career development of researchers. The Charter and the Code ensure that researchers enjoy the same rights and obligations in any European country.

The European Framework for Research Careers (EU, 2011) includes a framework implemented by the European Research Area (ERA; https://ec.europa.eu/info/research-and-innovation/strategy/era_en; accessed 8 August 2019) to enable more comparable career structures across employment sectors and countries to produce transparency to European labour market. The framework introduces four profiles from a researcher up to a PhD (1st stage), through a recognized researcher not fully independent (2nd stage), through an established independent researcher (3rd stage) and to a researcher leading his/her research area or field (4th stage). The ERA principles for doctoral training are as follows: research excellence, attractive institutional environment, interdisciplinary research options, exposure to industry and other relevant employment sectors, international networking, transferable skills training and quality assurance (QA). The framework applies to all researchers fostering cross-border and cross-sector researcher mobility, and it is currently used in the EURAXESS Job Portal (https://euraxess.ec.europa.eu/jobs/search; accessed 8 August 2019).

There are also other documents referring to the competence of researchers. In 2007–2009, for example, European Science Foundation (ESF) developed a framework for a research career development in Europe. This framework included a joint skills statement defining 17 transferable skills in a research context as 'skills learned in one context (e.g. research) that are useful in another (e.g. future employment)'. These were applicable to a four-stage model of an academic research career starting from doctoral training to established researcher (ESF, 2009). The League of European Research Universities (LERU; https://www.leru.org/; accessed 8 August 2019), founded in 2002, is an association of some of the most renowned research universities in Europe and a prominent advocate of the promotion of basic research at European research universities. The League has expanded its membership to 23 universities based in 12 European countries in 2017. The League (LERU,) states that the training of doctoral graduates is in the centre of the mission of research-intensive universities (RIUs). Doctoral programmes in LERU aim to train new researchers to the highest skill levels, who are creative, critical and autonomous intellectuals expanding the realm of research. The modern doctorate needs to prepare researchers for

careers in public, charitable and private sectors that require skills in deep and rigorous analysis, and universities must ensure that they maintain doctoral training embedded in a strong research culture using QA processes which scrutinize and enhance this culture and activities. According to LERU, research plays an essential role in the innovation process significantly contributing to the progress of society. LERU aims at furthering politicians', policymakers' and opinion leaders' understanding of the important role and activities of RIUs.

The topic of competence of researchers has attracted interest also in individual countries. The UK GRAD Programme and Research Councils, established in 2001, are important in setting standards and identifying best practices in research training. The Research Councils' statement defines the skills that doctoral research students funded by the Research Councils are expected to develop during their training. The statement aims to provide a common view of the skills and experience of a typical research student thereby providing universities with a clear and consistent message helping them to ensure that all research training is of the highest standard.

In the USA, The NPA was established in 2002 to foster improvements to the postdoctoral situation in achieving administrative and policy changes. Its mission is to improve the postdoctoral experience by supporting enhanced research training and culture of enhanced professional growth to benefit scholarship and innovation. The aim of NPA is to work in collaboration with the entire research community and to change the culture of those individuals and institutions engaged in the U.S. research enterprise so that the contributions of postdoctoral scholars are fully valued and recognized. NPA defines six core competences for postdoctoral researchers serving as a basis for self-evaluation and for developing training opportunities that can be evaluated by mentors, institutions and other advisers. The aim of the postdoctoral fellowship is to provide the training that is necessary for the postdoctoral researcher to achieve intellectual and professional independence and success (NPA/https://www.nationalpostdoc.org/page/About).

In 2010, Research and Advisory Centre Limited© (CRAC; Vitae® 2010; https://www.vitae.ac.uk/about-us; accessed 8 August 2019) launched The Researcher Development Framework (RDF) as an approach to researcher development based on empirical data collected from researchers. RDF is a professional development framework for planning, promoting and supporting the personal, professional and career development of researchers in higher education, articulating the knowledge, behaviours and attributes of successful researchers and encouraging them to realize their potential. It enables researchers to evaluate and plan their professional development, managers and supervisors to support the development of researchers and trainers, and developers, human resources specialists and career advisors to plan and support researcher development (Vitae, 2010). RDF aims to influence the implementation of effective policy relating to researcher development, to enhance higher education provision to train and develop researchers, to empower researchers to make an impact in their careers and to evidence the impact of professional and career development support for researchers (https://www.vitae.ac.uk/about-us).

In all these existing frameworks, the interest lies in the beginning of a research career, including PhD education or postdoctoral phase, or both. They also have many similarities in the competence domains. In the following chapters, we will analyse the existing scientific research in the field of competences, in terms of used methodological choices and creating, defining or using the competences.

2 | METHODS

This review followed the reporting guidelines of PRISMA Extension for Scoping Reviews (PRISMA-SCR; Tricco, Lillie, & Zarin, 2018) and the five-stage framework developed by Arksey and O'Malley (2005). This scoping review was undertaken as two-pronged focusing first on the findings concerning the required competences for a researcher career and, second, on the methodological choices used in the studies.

2.1 | Stage 1. Identifying the research question

1. What competences are required in the beginning of the research career of PhD students and postdoctoral researchers?
2. What methodological choices have been used to study competences?

2.2 | Stage 2. Identifying relevant studies

The search strategy was developed with a librarian having expertise in data searches and working in the university library of the principal researchers of this study. The following databases were used: PubMed, CINAHL, SocIndex, PsycInfo, Eric, EMBASE, Academic Search Premier and Scopus using Boolean combination of keywords as follows: PubMed/PsycINFO: (((doctoral OR phd OR postgraduate*) AND (candidate* OR student* OR education*)) OR postdoc* OR post doc* OR (principal AND investigator*)) AND competenc* AND leadership*and Scopus/ Eric/Embase/CINAHL/SocIndex/Academic Search Premier/Web of Science (((Doctoral OR phd OR postgraduate*) AND (candidate* OR student* OR education*)) OR postdoc* OR "post doc*" OR (principal AND investigator*)) AND competenc* AND leadership*.

2.3 | Stage 3. Study selection

Altogether 44 studies were included (N = 44). The inclusion criteria were as follows: (a) an empirical study, (b) related to any scientific field, (c) related to PhD students and/or postdoctoral researchers (with a PhD), (d) related to competence, (e) full text available, (f) published in English in a peer-reviewed journal and (g) published between January 1990 and November 2018. The exclusion criteria were as follows: (a) theoretical or descriptive article and (b) related to Doctor of Practice.

TABLE 1 Existing competence frameworks and the review competence domains

	European Science Foundation (2009)	European Charter for Researchers, EU (2005)	Bologna Declaration/European Framework for Research Careers (2011)	Bologna Declaration/European Framework for Research Careers (2011)
	Doctoral candidates and postdoctoral researchers	All stages of doctoral career	Doctoral candidates	Postdoctoral researches
Competence domain	Competences			
1. Knowledge base	Knowledge of research methods and techniques-beyond the doctoral project		Carry out research under supervision Have the ambition to develop knowledge of research methodologies and discipline Have demonstrated a good understanding of a field of study Have demonstrated the ability to produce data under supervision	Carry out research Have the ambition to develop knowledge of research methodologies and discipline Have demonstrated a good understanding of a field of study Have demonstrated the ability to produce data Has demonstrated a systematic understanding of a field of study and mastery of research associated with that field Has made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, innovation or application. This could merit national or international refereed publication or patent
2. Cognitive abilities			Be capable of critical analysis, evaluation and synthesis of new and complex ideas	Demonstrates critical analysis, evaluation and synthesis of new and complex ideas
3. Creativity	Creativity and the ability for abstract thought			
4. Personal qualities				
5. Self-management				
6. Professional and career development	Career planning skills Networking skills Negotiation skills	Professional attitude		Takes ownership for and manages own career progression, sets realistic and achievable career goals, identifies and develops ways to improve employability

The League of European Research Universities (2016)	National Postdoctoral Association (2002)	UK GRAD/UK Research Councils (2001)	Researcher Development Framework/Vitae (2010)	Scoping review
Doctoral candidates	Postdoctoral researchers	Doctoral candidates	All stages of doctoral career	All stages of doctoral career
				Competence domain
Understand, test and advance complex theories or hypotheses and to deploy sophisticated concepts, methodologies and tools in the chosen subject to a very high level Be able to identify issues and translate them into questions amenable to scholarly enquiry Successfully pursue original research in the chosen field Use critical judgment in an objective manner based on verifiable evidence Deploy specific technical, research-related tools and techniques Apply highest standards of rigour in the proof of ideas Manage a high degree of uncertainty both in method and in outcomes	Analytical approach to defining scientific questions Design of scientifically testable hypotheses Broad-based knowledge acquisition Literature search strategies and effective interpretation Experimental design Principles of the peer review process Laboratory techniques and safety	The ability to recognize and validate problems Show a broad understanding of the context, at the national and international level, in which research takes place Original, independent and critical thinking and the ability to develop theoretical concepts A knowledge of recent advances in one's field and in related areas An understanding of relevant research methodologies and techniques and their appropriate application in one's research field Justify the principles and experimental techniques used in one's own research	Using subject knowledge in research Research methods: theoretical knowledge and practical application Using information seeking and information literacy and management skills in research Using languages and academic literacy and numeracy in research	Research field Research skills Research communication
Think analytically and synthetically Be creative, inquisitive and original Take intellectual risks	Interpretation and analysis of data Statistical analysis Data analysis and interpretation	The ability to critically analyse and evaluate one's findings and those of others An ability to summarize, document, report and reflect on progress	Using analysis and synthesis in research Using critical thinking and evaluation in research Using problem-solving in research	Cognitive competence
		Be creative, innovative and original in one's approach to research Demonstrate flexibility and open-mindedness Demonstrate self-awareness and the ability to identify own training needs	Using an inquiring mind and intellectual insight to meet the challenges of research Using innovation in research Argument construction and intellectual risk in research	Cognitive competence
Persist in achieving long-term goals Manage projects with uncertain outcomes in diverse settings and organizations Take a project through all its stages: from developing the original idea, to developing a plan, garnering the evidence and communicating the results and their significance Be self-motivated and autonomous Work to achieve results with minimum supervision Be flexible and adaptable in approaching complex and uncertain problems		Demonstrate a willingness and ability to learn and acquire knowledge Demonstrate self-discipline, motivation and thoroughness Recognize boundaries and draw upon/use sources of support as appropriate Show initiative, work independently and be self-reliant	The need for enthusiasm and perseverance as a researcher Integrity for good practice in research The importance of self-confidence for researchers Self-reflection for researchers Researchers' responsibilities	Self-management Research ethics
		Demonstrate awareness of issues relating to the rights of other researchers, of research subjects and of others who may be affected by the research, for example confidentiality, ethical issues, attribution, copyright, malpractice, ownership of data and the requirements of the Data Protection Act Demonstrate appreciation of standards of good research practice in their institution and/or discipline	Preparation and prioritization in research Commitment to research The importance of time management for researchers Responsiveness to change for researchers Managing work–life balance as a researcher	Self-management Research ethics
Develop and demonstrate academic credibility and become recognized as a member of an international scholarly community Understand the workings of a specific high-level research-intensive environment Network internationally		Take ownership for and manage one's career progression, set realistic and achievable career goals and identify and develop ways to improve employability Demonstrate an insight into the transferable nature of research skills to other work environments and the range of career opportunities within and outside academia Develop and maintain co-operative networks and working relationships with supervisors, colleagues and peers, in the institution and the wider research community	Managing your career and continuing professional development for researchers Taking advantage of opportunities available to researchers The value of networking as a researcher Reputation and esteem for researchers	Career management Future vision Intercultural management Team working

(Continues)

TABLE 1 (Continued)

	European Science Foundation (2009)	European Charter for Researchers, EU (2005)	Bologna Declaration/European Framework for Research Careers (2011)	Bologna Declaration/European Framework for Research Careers (2011)
7. Professional conduct	Research ethics and research integrity	Research Freedom Ethical principles Professional responsibility Contractual and legal obligations Accountability Good practice in research		
8. Research management				
9.Finance, funding and resources	Grant application writing skills			
10. Working with others	Working with others/team working Mentoring and supervisory skills	Supervision and managerial duties		
11. Communication and dissemination	Communication/presentation skills, both written and oral Communication/dialogue with non-technical audiences (public engagement)	Dissemination, exploitation of results	Be able to explain the outcome of research and value thereof to research colleagues	Be able to explain the outcome of research and value thereof to research colleagues Can communicate with their peers—be able to explain the outcome of their research and value thereof to the research community Co-authors papers at workshop and conferences Can communicate with the wider community and with society generally, about their areas of expertise
12. Engagement and impact	Enterprise skills (entrepreneurship, commercialization, innovation, patenting and knowledge transfer) Use of science in policy making	Public engagement		Can mentor First Stage Researchers, helping them to be more effective and successful in their R&D trajectory Understands the agenda of industry and other related employment sectors Understands the value of their research work in the context of products and services from industry and other related employment sectors Can be expected to promote, within professional contexts, technological, social or cultural advancement in a knowledge-based society

The search strategy provided a total of 2,687 articles including 37 articles found through manual search. After removing duplicates (N = 498), the titles of 2,189 articles were screened with 1,473 articles excluded and abstracts of 716 articles screened with 658 articles excluded, leaving a total of 58 articles for reading of full text, of which 14 articles were excluded. This left 44 articles to be included (Figure 1). Two researchers independently assessed the studies based on the title and abstract. After a consensus was reached, full texts of the selected studies were assessed independently by the same two researchers.

2.4 | Stage 4. Charting the data

Charting the data focused on describing the following study characteristics: author/s, year of publication and country of origin and competences required by doctoral researchers. Methodological choices were research

The League of European Research Universities (2016)	National Postdoctoral Association (2002)	UK GRAD/UK Research Councils (2001)	Researcher Development Framework/Vitae (2010)	Scoping review
Work according to ethical principles	Conflicts of Interest Data Ownership and Sharing Publication Practices and Responsible Authorship Identifying and mitigating research misconduct Research with human subjects (when applicable) Research involving animals (when applicable	Understand relevant health and safety issues and demonstrate responsible working practices Understand one's behaviours and impact on others when working in and contributing to the success of formal and informal teams Listen, give and receive feedback and respond perceptively to others	Health and safety, legal requirements, IPR and copyright for researchers Ethics, principles and sustainability in the context of research The need for respect and confidentiality in research Criteria for attribution and co-authorship in research Appropriate practice in research	Research ethics
	Leadership-Strategic Vision Leadership-Motivating and Inspiring Others Management Project Data Management and Resource Management Research Staff Management	Appreciate the need for and show commitment to continued professional development Use information technology appropriately for database management, recording and presenting information Apply effective project management through the setting of research goals, intermediate milestones and prioritization of activities Design and execute systems for the acquisition and collation of information through the effective use of appropriate resources and equipment Identify and access appropriate bibliographical resources, archives and other sources of relevant information	Research strategy Project planning and delivery for research Risk management in research	Research skills Team working Team leadership Resources management Technology
		Grant application writing skills	Income and funding generation, financial management, infrastructure and resources for research	Resources management
Work in a team Transfer new knowledge to scholarly communities and communicate it to society Work in an interdisciplinarity setting or on an interdisciplinary topic	Workplace Institutional Collegial Universal		Collegiality, mentoring, influence, leadership and collaboration in research Team working for success as a researcher Managing people to achieve research aims Supervision in research Equality and diversity in the research environment	Team working Team leadership Research communication Pedagogy Intercultural competence
Communicate very complex concepts Speak and present effectively in public	Writing Speaking Teaching Interpersonal	Write clearly and in a style appropriate to purpose, for example progress reports, published documents, thesis Construct coherent arguments and articulate ideas clearly to a range of audiences, formally and informally through a variety of techniques Constructively defend research outcomes at seminars and viva examination	Communication methods and media for researchers Publish your research	Research communication Implementation
		Understand the process of academic or commercial exploitation of research results Effectively support the learning of others when involved in teaching, mentoring or demonstrating activities Contribute to promoting the public understanding of one's research field	The role of teaching in research Engaging the public with research Enterprise and research Policy in research Making a difference to society and culture through research Global citizenship in research	Pedagogy Implementation Research communication Intercultural competence

design; setting; sampling; data collection and data analysis; and considerations concerning study limitations and research ethics (Table 2).

2.5 | Stage 5. Summarizing the data

Collating, summarizing and reporting the results were conducted in accordance with the research questions using both quantitative and qualitative analyses in description of the studies.

3 | RESULTS

3.1 | Required competences for a researcher career identified in the scoping review

The competences of the researchers included management of 15 domains: (1) research field; (2) research skills; (3) research ethics; (4) cognitive competence; (5) self-management; (6) research

communication; (7) team working; (8) team leadership; (9) resources; (10) career; (11) pedagogy; (12) implementation; (13) future vision; (14) technical competence; and (15) intercultural competence. Competences were not exclusive between the categories. Many individual competences manifested themselves in different contexts within competence domains (Tables 1 and 2).

3.1.1 | Management of research field

Management of research field entailed a vast discipline-related knowledge base (Freeman & Kochan, 2012; Lou & Chen, 2008; Pitt & Mewburn, 2016) and fundamental knowledge of research and study management (Harland & Plangger, 2004; Lambie, Hayes, Griffith, Limberg, & Mullen, 2014; Maynard, Labuzienski, Lind, Berglund, & Albright, 2017; Murakami-Ramalho, Militello, & Piert, 2013; Petr et al., 2015).

3.1.2 | Management of research skills

Management of research skills referred to understanding of the scientific method and research process (Harrison, Hernandez, Cianelli, Rivera, & Urrutia, 2005; Stubb, Pyhältö, & Lonka, 2014). Knowledge of research methodology included managing databases and searches, knowledge of research designs and an ability to formulate research questions, to know and elaborate research frameworks and to be familiar with statistical programmes and analyses (Baltes, Hoffman-Kipp, Lynn, & Weltzer-Ward, 2010; Harrison et al., 2005; Lim, Daniels, & Watkins, 2008; Sunderland, 2004) as well as scholarly and researcher skills including writing research proposals (Hyatt & Williams, 2011; Lou & Chen, 2008; Welton, Mansfield, Lee, & Young, 2015).

3.1.3 | Management of research ethics

Management of research ethics referred to knowing the ethical principles of research including ethics and legal practice related to research design, data collection, dissemination and use, human subject protection and confidentiality and specific populations (Huber, Fennie, & Patterson, 2015; Löfström & Pyhältö, 2014). It refers to having integrity (Skoulas & Kalenderian, 2012) and to taking responsibility in carrying out research (Baker & Pifer, 2011; Freeman & Kochan, 2012). Professionalism was also included as an element of ethics management. It entailed commitment to professional development, professional behaviour in the form of researcher identity and independent scholar (Baker & Pifer, 2011; Horta, 2009; Murakami-Ramalho et al., 2013; Pitt & Mewburn, 2016; Romano, Townsend, & Mamiseishvili, 2009; Saunders & Cooper, 1999; Sorge, Bennett, & Milligan, 2018).

3.1.4 | Cognitive competence

Cognitive management referred to an ability to generate research ideas, to construct theoretical models and theories, to formulate policies and to establish research programmes (Harrison et al., 2005; Welton et al., 2015). Cognitive competence entailed intellectual flexibility and ability to see things from multiple perspectives as well as critical and innovative thinking (Anttila et al., 2015; Brodin, 2016; Freeman & Kochan, 2012; Hyatt & Williams, 2011; Lee, 2008; Lou & Chen, 2008). Evaluation skills in reading research critically and assessing research validity were expected competencies (Harrison et al., 2005; Huber et al.., 2015; Saunders & Cooper, 1999).

3.1.5 | Self-management

Self-management manifested itself as research and supervisor self-efficacy (Baltes et al., 2010; Frick & Glosoff, 2014; Huber et al., 2015; Lambie et al., 2014) and self-management (Baker & Pifer, 2011; Freeman & Kochan, 2012; Saunders & Cooper, 1999; Skoulas & Kalenderian, 2012) needing self-discipline (Anttila et al., 2015; Lim et al., 2008), self-determination (Kim, Morningstar, & Jung, 2014), self-reflection (Anttila et al., 2015; Foot, Growe, Tollafield, & Allan, 2014; Maynard et al., 2017) and self-confidence (Ferguson, 2009; Larcombe, McCosker, & O'Loughlin, 2007). Researchers also needed willingness to personal development (Lee, 2008; Oktay, Jacobson, & Fisher, 2013). Self-management entailed personal attributes such as an ability to build trust, independence, compassion, empathy, emotional intelligence and adaptivity (Hyatt & Williams, 2011; Lim et al., 2008; Skoulas & Kalenderian, 2012; Sorge et al., 2018). Piercy et al. (2005) emphasized understanding researcher training also as a social process.

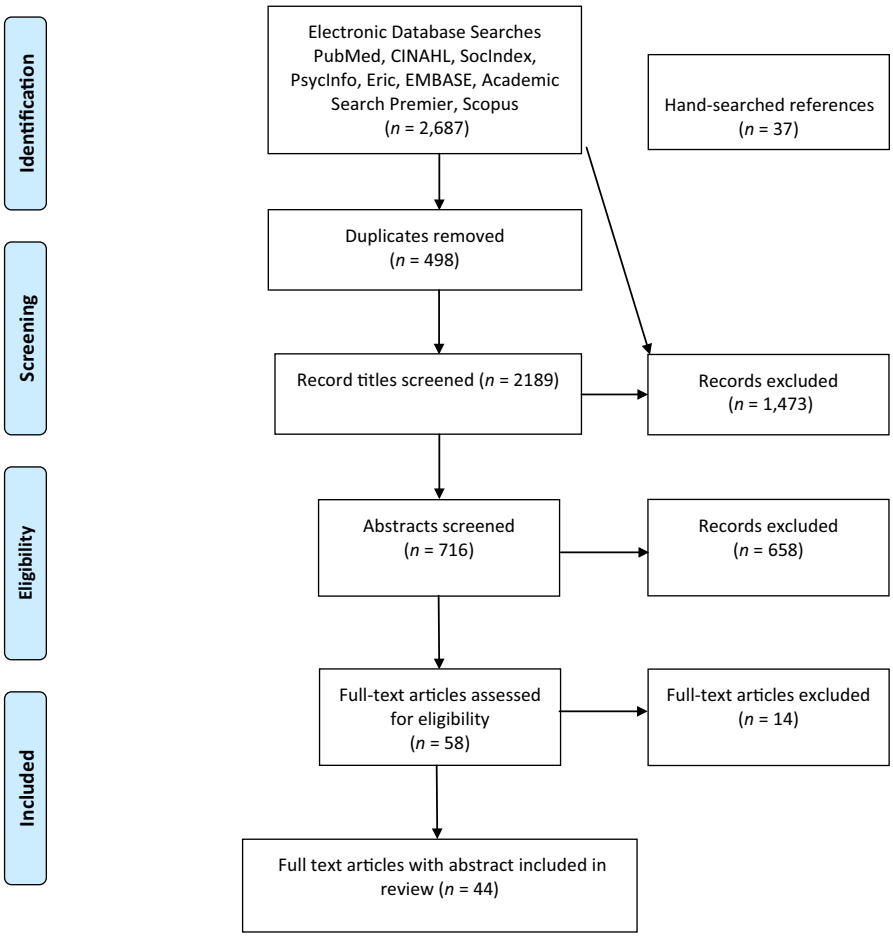
3.1.6 | Management of research communication

Management of research communication meant scientific productivity through publications and oral presentations (Freeman & Kochan, 2012; Horta, 2009; Hyatt & Williams, 2011; Welton et al., 2015). This entailed an ability to write and review academic articles (Anttila et al., 2015; Ferguson, 2009; Freeman & Kochan, 2012; Lariviere, Sugimoto, & Bergeron, 2013; Petr et al., 2015; Welton et al., 2015) and to learn, prepare and receive critique in writing (Caffarella & Barnett, 2000; Can & Walker, 2011). Knowledge exchange and facilitation and dissemination of research findings were required (Anttila et al., 2015; Harrison et al., 2005; Horta, 2009; Murakami-Ramalho et al., 2013; Pitt & Mewburn, 2016). Understanding the culture and politics of the university and department and supporting their mission in increasing programme and university prestige were expected (Hyatt & Williams, 2011).

3.1.7 | Management of team working

Management of team working meant building and being active in scientific community including peer collaboration and student contacts (Baker & Pifer, 2011; Hyatt & Williams, 2011; Larcombe et al., 2007; Lim et al., 2008; Murakami-Ramalho et al., 2013). It entailed networking in the academic community and outside the university (Harrison et al., 2005; Horta, 2009; Maher et al., 2008; Pitt & Mewburn, 2016).

FIGURE 1 Flow chart of data searches



Team working meant interpersonal, interprofessional and interdisciplinary communication skills including dialogue, consultancy and valuing of others (Ferguson, 2009; Foot et al., 2014; Freeman & Kochan, 2012; Holley, 2015; Hyatt & Williams, 2011; Naylor, Chakravarti, & Baik, 2016; Sorge et al., 2018; Welton et al., 2015).

3.1.8 | Management of team leadership

Management of team leadership meant ability to establish and lead research teams and to manage research projects independently (Harrison et al., 2005; Lee, 2008; Skoulas & Kalenderian, 2012; Sorge et al., 2018). It also entailed administrative and communication skills (Pitt & Mewburn, 2016; Romano et al., 2009) and an ability to influence (Skoulas & Kalenderian, 2012). Crisis management, conflict negotiation and resolution including dealing with difficult personalities and advocacy skills were expected (Romano et al., 2009; Skoulas & Kalenderian, 2012; Sorge et al., 2018; Welton et al., 2015). Also, knowledge of organizational strategies was important (Romano et al., 2009).

3.1.9 | Management of resources

Management of resources entailed identifying funding and abilities to write CVs and to apply grants (Freeman & Kochan, 2012; Harrison et al., 2005; Ku, Lahman, Yeh, & Cheng, 2008; Pitt & Mewburn, 2016; Romano et al., 2009; Saunders & Cooper, 1999).

3.1.10 | Management of career

Management of career referred to setting goals and improving employment opportunities. For doctoral researchers, it entailed job searching skills and a strong motivation to seek advanced education and academic career as personal goals (Ku et al., 2008).

3.1.11 | Management of pedagogical elements

Management of pedagogical elements referred to the ability to teach at the university level (Harland & Plangger, 2004; Ku et al., 2008; Petr et al., 2015). Teaching required scholarship both in teaching and research, pedagogical understanding and knowledge of teaching and learning theories (Anttila et al., 2015; Hyatt & Williams, 2011; Maynard et al., 2017). It also required knowledge of accreditation and educational policies (Maynard et al., 2017) and experience with organizational trends in teaching (Hyatt & Williams, 2011). Doctoral researchers had to manage different teaching methods and use of technology in teaching. Teaching also required skills in classroom management and management of course and curriculum designs, in student evaluation and assessment. The teacher role included

TABLE 2 Study matrix of PhD and postdoctoral researcher competences (*N* = 44)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
Qualitative studies (N = 22)							
1	Baker and Pifer (2011), USA	To examine the role of students' relationships in the identity development process during the transition to independent scholar	*Qualitative*	Doctoral Students (PhD and DEd) *N* = 31	Content analysis	None *None*	Research ethics Self-management Team working Future vision
2	Baltes et al. (2010), USA.	To understand factors related to doctoral students' research course—experiences that enhance students' skill development and self-efficacy to handle research projects and related factors	*Qualitative* Exploratory case study method Pilot study	PhD student in Education *N* = 1	Content analysis Discussion analysis	None *None*	Research skills Self-management
3	Brodin (2016), Sweden	To explore the meanings and conditions of critical and creative thinking according to students' learning experiences	*Qualitative*	Doctoral students *N* = 14 Their supervisors *N* = 14	Life-world analysis	None 1. Swedish guidelines conducting research 2. Approval of ethical committee 3. Anonymity guarantee 4. Informed about the study 5. Withdrawal possible	Cognitive competence Future vision
4	Caffarella and Barnett (2000), USA	To explore doctoral students' perceptions of the process of academic writing	*Qualitative*	Doctoral students *N* = 45	Inductive content analysis	1. Limited sample 2. From a single doctoral programme 3. Results cannot be generalized 4. Whether students were honest? *None*	Research communication
5	Chen (2014), Canada	To explore how doctoral candidates perform as researchers in final oral examination in 'difficult questions'	*Qualitative*	Doctoral candidates *N* = 11 • multi-case study	Inductive content analysis	None *None*	Future vision
6	Foot et al. (2014), USA	To explore how daily experiences and practices as a doctoral student influence identity as a doctoral student and emerging scholar	*Qualitative*	Doctoral students *N* = 3	Simultaneous data generating and analysis = Constant comparative approach	None *None*	Self-management Team working
7	Frick and Glosoff (2014), USA	To investigate doctoral students' experiences and perceptions of self-efficacy as supervisors	*Qualitative* Phenomenological	Doctoral students in counsellor education *N* = 16 Criterion sampling	Miles & Haberman analysis Inductive content analysis Deductive verification	1. Researcher perspective 2. Participant bias 1. *Institutional review board approval*	Self-management

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
8	Harrison et al. (2005), USA	To identify/indicate research competencies of bachelor's, master's and doctoral students perceived by professors and leaders	*Qualitative*	Directors and professors of nursing schools in Latin America *N* = 200 (9 doctoral and 1 postdoctoral preparation responded) Convenience sampling with snowballing	Content analysis	1. Small sample size 2. Few countries participate 1. *Approval by Institutional review board*	Research skills Cognitive competence Research communication Team working Resources management Team leadership Pedagogy
9	Holley (2015), USA	To understand the development of interdisciplinary identity in PhD students	*Qualitative*	PhD students *N* = 40 Purposeful sampling with snowballing	Content analysis	None *1. Confidentiality*	Team working
10	Hyatt and Williams (2011), USA	To explore competencies necessary for doctoral faculty members teaching in doctoral leadership programmes	*Qualitative*	PhDs representing university faculty *N* = 10	Content analysis	1. Single-site study 2. Narrow perspective 3. Results preliminary 1. *Approval by University Institutional Review Board*	Research field Cognitive competence Self-management Research communication Team working Pedagogy Future vision Technology Intercultural management
11	Ku et al. (2008), USA	To explore international doctoral students' perspectives of their graduate school experience and their perceptions of support with preparedness for an academic career before and after the support group	*Qualitative* -case study	International doctoral in different disciplines *N* = 12 Purposive sampling	Statistical Inductive content analysis	None *None*	Resources management Career management Pedagogy
12	Lee (2008), UK	To explore PhD supervisors' perspectives on PhD development	*Qualitative*	PhD supervisors *N* = 12 Purposive sampling	Inductive content analysis	None 1. *University ethical committee approval* 2. *Code of Practice of The British Psychological Society* 3. *Written consent* 4. *The interviewees had an opportunity to review their transcripts* 5. *Face validity*	Cognitive competence Self-management Team leadership Future vision

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
13	Lim et al. (2008), USA	To explore doctoral students' online learning experiences, particularly major challenges and benefits of online course in advanced research methods and make sense of it.	*Qualitative*	Doctoral students *N* = 17 Interview Convenience sampling Open-ended questions from a survey *N* = 58	Thematic analysis	1. Single location *None*	Research skills Self-management Team working Technology
14	Löfström and Pyhältö (2008), Finland	To identify ethical issues in supervision relationship by students in natural and behavioural sciences during their doctoral programmes to support individuals and research communities in identifying potential ethical pitfalls and to help them to create ethically sustainable solutions	*Qualitative*	PhD students *N* = 28 Convenience sampling Semi-structured interviews	Theory-driven analysis using Kitchener's (1985, 2000) five ethical principles framework	1. Small sample 2. Generalizability limited *None*	Research ethics
15	Maher et al. (2008), Australia	To investigate doctoral students' experiences in participating in writing groups from students' ow perspective	*Qualitative*	Doctoral students *N* = 6	Content analysis	None *None*	Team working
16	Naylor et al. (2016), Australia	To study PhD students' experiences and expectations concerning their studies	*Qualitative*	PhD researchers *N* = 14 PhD students with clinical background *N* = 15	Thematic analysis	1. Single-site study 2. Generalizability 1. *Ethics approval from participating university* 2. *Informed consent*	Team working
17	Nelson et al. (2008), USA	Exploring students' experiences to become a supervisor	*Qualitative* Grounded theory	Doctoral students *N* = 13	Individual and Focus group interviews	1. Small number of participants 1. *Approval of institutional review board*	Pedagogy
18	Oktay et al. (2013), USA	To study how social work doctoral students learn to teach	*Qualitative* Grounded theory	Purposeful sampling -> Theoretical sampling Social work doctoral students *N* = 14 Interview	Computerized analysis Constant comparison, coding until saturation	None 1. *Institutional review board approval* 2. *Informed consent* 3. *Anonymity* 4. *Identification number to guarantee confidentiality*	Self-management Pedagogy
19	Piercy et al. (2015), USA	To explore students' perceptions of research and their beliefs of what would strengthen the research culture in their training programmes	*Qualitative*	Interview Convenience sampling Family therapy doctoral students *N* = 14	Inductive content analysis Constant comparison	None None	Self-management

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
20	Pitt and Mewburn (2016), Australia	To understand, what skills and attributes graduate PhDs should have to prepare them for academic work, that is employers' expectations PhD's academic job requirements in universities' advertisements	*Qualitative* Exploratory Comparative	Papers and reports = Job descriptions on university websites *N* = 155 Electronic job Advertisements	Content analysis Critical analysis	1. Small and localized data *None*	Research field Research ethics Research communication Team working Team leadership Resources management
21	Stubb et al. (2014), Finland	To investigate how doctoral students perceive their research work in the context of their own PhD project • conceptions of conducting research • thesis process • how they perceived themselves in it • motivation • experience of doing PhD • impressions of supervision	*Qualitative*	PhD students *N* = 32	Phenomenographic analysis	1. Broad perspective in the interviews 2. One-time interview *None*	Research skills
22	Sunderland (2004), UK	To investigate rationale behind doctoral PhD students' data selection	*Qualitative*	PhD students *N* = 54	Content analysis	None *None*	Research skills
Quantitative studies (N = 13)							
23	Ferguson (2009), Jamaica	To evaluate the elements of an academic writing course in terms of contents, suggestions for changes, pros and cons, usefulness of the group and helpfulness of course aspects such as readings, discussions, peer review in-class and at-home writing activities, etc.	Quantitative Evaluation	Doctoral students *N* = 24 Convenience sampling	Evaluation form/5-point Likert	None *None*	Self-management Research communication Team working
24	Horta (2009), Portugal/Data from Mexico	To look what is the information exchange dynamics of academics and what are the benefits that doing a post doc brings?	Quantitative	Faculty members of Higher education academics *N* = 492 PhD = 389 Postdoc = 103	Statistical	None *None*	Research ethics Research communication Team working
25	Huber et al. (2015), USA	To identify core competencies for epidemiologic training at the master and doctoral levels	Quantitative	Epidemiologists *N* = 147 ->Recent graduates *N* = 36 *N* = 183	Statistical	*Institutional review board approval*	Research ethics Cognitive competence Self-management Technology

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
26	Jepsen et al. (2012), Australia	To explore university academics' attitudes towards university teacher training (= PhD)	Quantitative Descriptive	University academics *N* = 1,108 -> *N* = 473 Response rate 43%	Statistical	1. Single-site study 2. Descriptive only 3. Generalizability weak 4. Academics' view only None	Pedagogy
27	Kim et al. (2014), USA	1. To investigate doctoral students' in education knowledge and attitudes towards self-determination 2. To examine the relationship between self-determination course-work and doctoral students' perceptions how well they were prepared for implementing self-determination in their future career	Quantitative descriptive correlation	Doctoral students in education *N* = 118 Piloted for - face and expert validity	Statistical • descriptive • cross-tabulation • □2	1. Convenience sampling 2. Unknown response rate 3. Self-report data 1. *Information letter*	Self-management
28	Lambie et al. (2014), USA	To investigate PhD students' level of research self-efficacy, interest in research and research knowledge and their relationship with demographic variables in three cohorts	Quantitative Correlation Cross-sectional	PhD students in education *N* = 67 Convenience sampling	Statistical • descriptive • Multiple Linear Regression Pearson correlation ANOVA	1. Extraneous variables not taken into account 2. Small sample size and 3. Education students only 4. Limited generalizability 5. Self-report bias 6. Voluntary participation may cause bias 1. *Institutional review board approval* 2. *Informed consent*	Research field Self-management
29	Lariviere et al. (2013), Canada	To investigate differences in referencing patterns between faculty members and students across all disciplinary areas (i.e. health, natural sciences and engineering, social sciences and humanities) To investigate information-seeking behaviours	Quantitative Correlation	Scientific articles *N* = ?	Quantitative content analysis	None *None*	Research communication
30	Lou and Chen (2014), Taiwan	1. To understand doctoral students' learning efficacy related to Nursing Research Seminar Course. 2. To understand differences in the perceived level of competency in terms of each course objective between doctoral students at different year levels in the programmes	Quantitative Cross-sectional	Doctoral students *N* = 25 Convenience sampling Survey questionnaire	Statistical	Small sample size limits generalizability • Related to a single course in one university • Limited course evaluation protocol *Anonymous data collection*	Research field Cognitive competence

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
31	Maynard et al. (2017), USA	To examine the extent to which US social work PhD programmes train their students to teach and how teaching is integrated into doctoral curricula charting the scope and content of teaching in the courses	Quantitative	PhD programme websites/ handbooks Syllabi of teaching courses Syllabi received *N* = 24 PhD programmes	Inductive/deductive quantitative content analysis	1. Limited sample size 2. Missing some teaching courses due to 'wrong' name 3. All content may not be covered in the syllabi = inaccurate syllabi? 4. Coding bias? 5. Outcomes of courses not included in the study 1. *Research Ethics Committee approval was not needed*	Research field Self-management Pedagogy Technology Intercultural management
32	Petr et al. (2015), USA	1. To examine the perceived importance of GADE quality indicators 2. Expectations concerning outcomes for social work PhD students	Quantitative	Survey	Statistical	1. Sample size and response rate not defined 2. Description of mainstream thoughts *None*	Research field Research communication Pedagogy
33	Romano et al. (2009), USA	To explore doctoral students' perceptions and development of leadership competencies	Quantitative Exploratory Descriptive	*N* = 153 Response rate 33% Piloted	Statistical	1. Low response rate *None*	Research ethics Team leadership Resources management
34	Saunders and Cooper (1999), USA	To determine chief student affairs officers' perceptions of the most important skills and competencies of new graduate doctoral students' aspiring mid-management positions	Quantitative	Chief student affairs officers *N* = 151	Statistical	None *None*	Research ethics Cognitive competence Self-management Resources management
35	Skoulas and Kalenderian (2012), USA	To assess the impact of leadership course on dental postdoctoral students	Quantitative	Dental postdoctoral students *N* = 21	Statistical	None *None*	Research ethics Self-management Team leadership
Mixed-method studies (N = 9)							
36	Anttila et al. (2015), Finland.	1. How Medical students perceive their future competencies 2. Are there differences between Medical and MSc PhD students' perceptions? What are students' perceptions of their learning environment and their experienced well-being? 1. *What is the added value of A PhD degree for MDs and MScs? 2. What should be learned from PhD studies from students' own perspective?	Mixed-method: Quantitative • descriptive Qualitative	Medical PhD students *N* = 163	Statistical Content analysis	1. Moderate response rate 2. Longitudinal and comparative studies needed *None*	Cognitive competence Self-management Research communication Pedagogy Future vision

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
37	Can and Walker (2011), USA	To investigate doctoral students' perceptions and attitudes towards written feedback about academic writing and its providers.	Mixed-method: *Qualitative* Quantitative Piloted	Doctoral students: Interviews *N* = 15 Questionnaire *N* = 276 Purposeful sampling	Statistical Constant comparative analysis technique	1. Convenience/Purposeful sampling 2. Two-site study 3. Fairly low response rate 4. Model only partly fit. 5. Validity and reliability of the study are limited/honesty? *None*	Research communication
38	Doyle et al. (2016), USA	To investigate faculty perspectives of faculty-to-student e-mentoring in an online postprofessional doctor of occupational therapy programme	*Qualitative* Quantitative	Structured interview Online survey Faculty members *N* = 9 Mentoring experiences *N* = 48	Statistical Qualitative content analysis	Small sample size and single location limit generalizability *Research Ethics Committee approval by institutional review board* *Recruitment letter and consent form*	Pedagogy
39	Freeman and Kochan (2012), USA	To examine university presidents' perceptions of their academic doctoral programme related to their preparation for the university presidency	Mixed-method: *Qualitative* Quantitative	University presidents *N* = 2,148 Qualitative *N* = 13		1. Small sample size 2. *Validity, reliability and* 3. *generalizability discussion*	Research field Research ethics Cognitive competence Self-management Research communication Team working Resources management Pedagogy Future vision
40	Harland and Plangger (2004), New Zealand	To describe postgraduate students' experiences acting as a researcher and a teacher	Mixed-method: *Qualitative* Quantitative	PhD and master's students *N* = 94 Interviews *N* = 25 PhDs	Statistical Content analysis	1. Low response rate *None*	Research field Pedagogy
41	Larcombe et al. (2007), Australia	To evaluate an academic writing skill course for PhD students A pilot study	Mixed-method: *Qualitative* Quantitative	PhD students *N* = 19	Evaluation formats	None *None*	Self-management Team working Implementation
42	Murakami-Ramalho et al. (2013), USA	To explore how Doctoral Students in Educational Administration Develop Research Knowledge and Identity	Mixed-method: *Qualitative* Quantitative	Focus group interviews *N* = 9 Personal narratives Survey PhD students *N* = 8 and Alumni *N* = 15	Inductive content analysis Dialogical analysis on narratives	None *None*	Research field Research ethics Research communication Team working Technology

(Continues)

TABLE 2 (Continued)

	Author (year), country of origin	Purpose/Aim	Research design	Sample	Data analysis	Limitations *Ethical considerations*	Competence concept
43	Sorge et al. (2018), USA	To articulate the impact of leadership development course on trainees including master's, doctoral and postdoctoral levels	Mixed-method: *Qualitative* Quantitative	Master's, doctoral and postdoctoral students *N* = 13 Convenience sampling	Statistical Content analysis	None *None*	Research ethics Self-management Team working Team leadership Pedagogy
44	Welton et al. (2015), USA	1. To explore the role of university educational leadership preparation programmes in preparing women leaders 2. a. How do graduate PhD students define mentorship b. What mentorship activities students experience? c. Are there gender differences? d. How can study methodology be strengthened in future?	Mixed-method: *Qualitative* Quantitative	PhD students *N* = 12 Doctoral students *N* = 78 Purposeful and random samplings	Statistical analysis Thematic qualitative analysis	1. Small sample size 2. Lack of generalizability 3. Lack of contextual elements in survey *None*	Research field Cognitive competence Research communication Team working Team leadership Pedagogy

mentoring and supervision, which should be student-centred, flexible, frequent, academically and psychologically supportive (Doyle, Jacobs, & Ryan, 2016; Hyatt & Williams, 2011; Maynard et al., 2017; Nelson, Oliver, & Capps, 2008; Oktay et al., 2013; Sorge et al., 2018). Speaking and presentation skills and role modelling were attributes of a professional teacher (Freeman & Kochan, 2012; Welton et al., 2015). Teaching research, ethics and philosophy were mentioned as teaching contents (Harrison et al., 2005; Hyatt & Williams, 2011; Maynard et al., 2017). At personal level understanding human diversity, commitment to lifelong learning and practice of self-assessment were essential. Self-assessment and self-reflection included acceptance of feedback and focusing on personal development as a teacher (Hyatt & Williams, 2011; Maynard et al., 2017; Oktay et al., 2013). Teaching skills developed doctoral researchers' professional identity (Harland & Plangger, 2004). However, Jepsen, Varhegyi, and Edwards (2012) regarded research skills more important than teaching skills in assessing PhD students' merits.

3.1.12 | Management of the implementation of research results

For doctoral researchers, it meant an ability to discuss research with healthcare professionals working in practice (Larcombe et al., 2007).

3.1.13 | Future visions

As future scholars, doctoral researchers were expected to have intellectual flexibility, be critical thinkers managing academic argumentation and be creative, innovative and adaptive in their thinking (Anttila et al., 2015; Brodin, 2016; Chen, 2014; Freeman & Kochan, 2012; Hyatt & Williams, 2011; Lee, 2008). Long-term planning skills were expected (Baker & Pifer, 2011).

3.1.14 | Management of technology

Management of technology referred to understanding communication technologies and managing virtual communication thus being able to use technology in research, teaching and collaboration (Huber et al., 2015; Hyatt & Williams, 2011; Lim et al., 2008; Maynard et al., 2017; Murakami-Ramalho et al., 2013).

3.1.15 | Intercultural management

For doctoral researchers, it meant ability to work with diverse groups, to accept and value others and to understand diversity of students in the teacher role (Hyatt & Williams, 2011; Maynard et al., 2017).

3.2 | Methodological choices of the studies

3.2.1 | General description of the studies

Retrieval of articles (*N* = 44) from 1990 onward showed that only the turn of the millennium revealed an increase in interest in studies

TABLE 3 Study settings and participants/data sources (*N* = 44)

Study setting/Discipline	*N*	%	Participants/data sources	Qualitative	Quantitative	Total
Educational sciences (behavioural science, leadership, pedagogy)	18	41	Doctoral students/PhD students	933	378	1,311
Various disciplines (unspecified)	8	18	Postdoc students/researchers	14	21	35
Humanities (linguistics, music, philosophy, social sciences)	9	21	PhD/Doctoral supervisors	26	0	26
Medical sciences (dentistry, epidemiology, medicine, neuroscience, nursing,)	8	18	University presidents (PhD)	13	2,148	2,161
Economics/Business	1	2	University academics (Directors/professors/faculty members, educators with various academic degrees, alumni, students: groups not specified by number)	61	1,327	1,388
Natural sciences	1	2	Chief student affairs officers	0	151	151
			Epidemiologists/recently graduated	0	183	183
			PhD programme Web-site handbooks	0	24	24
			Job descriptions on university websites	155	0	155
			Personal journal, activity logs and critical incident reports	3	0	3

focusing on competence requirements of doctoral researchers. Since then, the increase of interest has been rather fluctuating, the number of publications ranging from 0–7 per year. The studies originated from nine countries, the United States being the most productive in number of publications (*N* = 27; 61%). In other countries, the number of publications was five (Australia), three (Finland), two (UK, Canada) and one (Jamaica, New Zealand, Portugal, Taiwan).

3.2.2 | Research designs and settings

The research design was qualitative in a half of the studies (*N* = 22;50%) and quantitative in nearly one third of the studies (*N* = 13;20%), the rest being mixed-method studies (*N* = 9;20%) (Table 2). Most studies were descriptive, some complemented with a correlational design. All were carried out in university settings, the majority in the field of education or in multidisciplinary contexts. Other studies represented social and health sciences (Table 3). Researchers represented various stages of doctoral studies, or the stage of studies was not specified.

The main participant group in the studies were doctoral students. Furthermore, academics in different positions formed the other participant groups. Data were also retrieved from various documents. Particularly, the number of university presidents in one study (Freeman & Kochan, 2012) and the number of scientific articles analysed in another study (Lariviere et al., 2013) increased the total number of university academics and the number of documents (Table 3).

3.2.3 | Data collection and analysis

In the quantitative studies, the most used data collection method was a structured questionnaire. The majority were tailored structured surveys, some added with a few open-ended questions. A few validated instruments were used to study selected factors related to competences.

In qualitative studies, the most used data collection method was a structured or semi-structured interview carried out either individually or using a focus group. Data were also collected from published documents (Table 4). All data collection methods were based on participants' self-perception apart from document-based data.

Statistical methods were applied in quantitative studies, and inductive or thematic content analysis was mainly applied in qualitative studies, including mixed-method studies. Several other qualitative analysis methods were applied in individual studies (Table 4).

3.2.4 | Limitations and research ethics

A half of the studies reported limitations. The most common limitations were a small sample, a single or limited study site and a moderate or low response rate (Table 5).

About a third of studies reported ethical considerations. Ethical committee or the institutional review board approval to conduct the study was reported in nearly half of the studies. Any ethically demanding issues needing ethical consideration were not reported (Table 5).

TABLE 4 Data collection and analysis methods (*N* = 44)

Data collection methods	*N*	Analysis methods	*N*	%
Tailored questionnaires (Open ended: 3/ Structured: 12/ Mixed: 3)	18	Statistical	16	36
Semi-structured interview (individual/ focus group)	22	Content analysis (inductive/deductive/ thematic)	26	59
Research Self-Efficacy Scale (RSES) (Bieschke, Bishop & Garcia,1996)	1	Constant comparative analysis	3	7
RSES (Greeley et al. 1989)	1	Discussion/dialogical analysis	2	5
Interest in Research Questionnaire (Bishop & Bieschke, 1994)	1	Fenomenographic analysis	1	2
Research Knowledge Assessment (Lambie, 2012)	1	Life-world analysis	1	2
Survey by Kane (1983), modified by Fey and Carpenter (1996)	1	Critical analysis	1	2
Zinger Folkman Leadership Survey	1	Theory-driven analysis	1	2
American College of Epidemiology Education Committee Questionnaire (ACE)	2			
NRSS (Edwards, Bexley & Richardson, 2011) selection criteria	1			
Importance of quality indicators guided by CID (Walker, Golde, Jones, Bueschel,& Hutchings, 2008), Anasta's (2012) survey of social work doctoral students and CADE quality guidelines	1			
Doctoral students' Perceptions Toward Written Feedback for Academic Writing Questionnaire (Can & Walker, 2011)	1			
Evaluation form	1			
Assignment grades	1			
Instructor rubric	1			
Job descriptions on university websites/job advertisements	1			
PhD programme websites syllabi/handbook texts	1			
Personal journal/activity log/critical incident report/dialogue	1			
Personal narratives	1			
Observations	1			
Oral comments/discussions	2			
Interview notes/Researcher memos and reflections	1			
Research presentations	1			
E-mail comments	1			
Scientific articles	1			

4 | DISCUSSION

For the development of a discipline, the competence of researchers in the field is important. This scoping review provides a broad overview of competences required in the beginning of a research career, during the doctoral education or postdoctoral period. A description of existing frameworks and a scoping review of the scientific literature is presented. The main competencies identified in this review were seen as management of (1) research field; (2) research skills; (3) research ethics; (4) cognitive competence; (5) self-management; (6) research communication; (7) team working; (8) team leadership; (9) resources; (10) career; (11) pedagogy; (12) implementation; (13) future vision; (14) technical competence; and (15) intercultural competence.

These identified competences for doctoral researchers strongly correspond with competences in the existing frameworks thus corroborating the notion of essential competences (e.g., NPA/https://www.nationalpostdoc.org/page/CoreCompetencies; Vitae, 2010). However, direct comparison of competence domains and individual competences of the frameworks with the review domains and competences is cumbersome, since the naming of competence domains and individual competences varies greatly which may be related to the level of abstraction or hierarchy used in naming of competences (Vitae, 2010, Durrette et al., 2016). Thus, a common definition

TABLE 5 Limitations and ethical considerations (*N* = 44)

Limitations	*N*	%	Ethical considerations	*N*	%
None reported	20	46	None reported	29	66
Limited/small sample size	10	23	Institutional review board/ Ethical committee approval	19	43
Single-site/limited-site study	7	16	Informed consent	4	9
Participant bias/single-sided view/perspective	5	11	Confidentiality/Anonymity guaranteed	5	11
Moderate/low response rate	4	9	National/professional research guidelines followed	2	5
Unknown response rate	2	5	Participants informed about study/Information letter	2	5
Participant honesty	2	5	*Research Ethics Committee* approval not needed	1	2
Self-reported data	2	5	Withdrawal possible	1	2
Convenience sampling	2	5	Face validity assessment	1	2
Validity and reliability limitation discussed	2	5			
No sample size defined	1	2			
Voluntary participation bias	1	2			
Broad perspective in the interviews	1	2			
One-time interview	1	2			
Lack of contextual elements	1	2			
Results preliminary	1	2			
Extraneous variables not taken into account	1	2			

and naming of competences should be pursued and developed. Categorization of competences is also challenging since the individual competences can be placed in more than one domain. It would be helpful, for the use of competences in education and career development, to have an international agreement of the categorization of required competences.

The competences described in the review and frameworks cover a large area of human ability and intellectual capacity, not forgetting many personal attributes. To what extent and at what level these competences are expected from doctoral researches in reality may differ widely and depends on their employment and career status. Pitt and Mewburn (2016), for example, speak about 'academic superheroes' in their analysis of universities' job advertisements concluding that further 'exploration of the "new academic" would help to better understand the nature and purpose of academic work in preparing research students'.

In the reviewed studies, pedagogical competences were prominent with research competences including leadership in research. Pedagogical competences covered a large area of skills including not only traditional classroom teaching but also theories behind teaching and learning and awareness of educational policies. In supervisor role, a constructive management of student relationships was emphasized. The traditional career path of many PhDs has been to continue as university researchers and teachers may explain the importance of pedagogical skills.

Career management was the least addressed competence domain. In the context of the contemporary view of the PhD degree and researcher career also outside university, this competence domain should be addressed more profoundly (Hafsteinsdóttir et al., 2017).

The studies and the frameworks mainly described PhD level researcher development from the perspective of western academic world. Although doctoral training programmes seem to be similar worldwide, researchers seeking employment globally, particularly outside academia and, for example, in developing countries, might benefit from research to cover countries where cultural specifications affect the working environment (Bogle et al., 2011).

In terms of research designs, the studies used mainly a descriptive design offering evidence at a fairly low level. The findings were also extensively based on qualitative data using fairly small samples, limited contexts and researcher interpretations, all limiting generalizability (Polit & Beck, 2017). Nevertheless, the competences did not differ from the competences of the existing frameworks (Vitae, 2010) thus having a corroborative value. Study settings centred on

the fields of education and humanities, particularly social sciences. This prevalence may be explained by the basic nature of sciences, in that education and humanities focus on human development whereas natural sciences focus more on physical phenomena in nature. Participants' stage of doctoral studies was not emphasized but due to differences in doctoral programmes, their comparison would not have provided additional value to the review. However, various data sources in the studies widened the scope to define competences. Apart from data collected from various documents, the assessment of competences was based on participants' self-perceptions rather than objective analysis. Also including data collected from academics working with doctoral students provided perspectives to the discussion of competences.

Nursing science is not a separate entity among sciences. As the largest group of healthcare workers, nurses' contribution to the human health is significant. Therefore, educating high-quality nurse researchers is of a paramount importance to advance quality evidence-based nursing care worldwide. Project, such as Nurse Lead (2018), is an indication that nursing science has acknowledged and takes seriously the need to educate its doctoral students provided with competences needed in contemporary international research world (Hafsteinsdóttir et al., 2019).

Discussion of limitations in the analysed studies was fairly scarce and trivial relating to methodological issues such as small sample sizes or limited study sites. Although the studies did not require to tackle with demanding ethical considerations, the scarcity of discussion of research ethics was evident even in fairly recent studies.

The review covered various scientific fields and relevant databases. However, the data were solely retrieved from empirical studies. The prominence of the qualitative and descriptive research designs brought along different perspectives to look at competences compared with the existing frameworks.

There is a need for focused research on organizations, and employers interested in doctoral level educated employees to gain knowledge of competences important in work life. Research is also needed on how doctoral researchers and their employers assess the impact of researchers' competences in terms of job requirements and research on culture specific competencies in the global environment. Although the majority of competencies identified in this review concerned PhD students, particular attention should be paid on postdoctoral competences which cover the expanded role of contemporary PhD researcher seeking international employment and career also outside universities.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHORS CONTRIBUTIONS

O.N., H.V., T.H. and H.L-K.: substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data, drafting the manuscript or revising it critically for important intellectual content, and final approval of the version to be published.

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