Journal of Professional Nursing 57 (2025) 43–52

Contents lists available at ScienceDirect

Journal of Professional Nursing

journal homepage: www.elsevier.com/locate/jpnu

The development of the Postdoctoral Nurses Competence Scale: A Delphi consensus and content validity study

Annika Sterkenburg, MSc [a,b,*], Lisa J.C. van Dongen, MSc [c,d], Thóra B. Hafsteinsdóttir, PhD [a,b]

[a] Nursing Science department, Julius Center for Health Sciences and Primary Care, University Medical Centre Utrecht, Utrecht, the Netherlands
[b] Nursing Science, Program in Clinical Health Sciences, University Medical Center Utrecht, Utrecht, the Netherlands
[c] Department of Nursing Science, University of Turku, Turku, Finland
[d] CWZ Academy, Canisius Wilhelmina Ziekenhuis, Nijmegen, the Netherlands

ARTICLE INFO

Keywords:
PhD prepared nurse researcher
Postdoctoral nurse researcher
Professional competencies
Leadership development
Doctoral education

ABSTRACT

Background: PhD prepared nurses advance nursing science through research and integration of findings into practice. They demonstrate expertise in research, education, patient care, and policy. Various professional competencies are required for success in research, clinical practice, and education. Assessment of professional competencies is expected to stimulate competence and career development.
Aim: To reach consensus on professional competencies, develop an instrument to measure professional competencies of PhD prepared nurses and assess the content validity of the instrument.
Method: A Delphi consensus and content validity study was conducted using online questionnaires completed by international PhD prepared nurse researchers. The relevance of and agreement with the competencies were measures using Likert-scales and open-ended questions to determine consensus. The Postdoctoral Nurses Competence Scale was developed, and its content validity evaluated.
Results: Initially, four of 15 competencies were deemed 'very' or 'fairly' important by 18 PhD prepared nurses. In the second round with 13 adjusted competencies, eight competencies were rated 'very' or 'fairly' important. The content validity index scored 0.91.
Conclusion: Consensus was reached on most professional competencies, and the 13-item self-assessment instrument demonstrated excellent content validity. Further research is recommended to evaluate additional clinimetric properties before use of the instrument.

Introduction

In the rapidly changing healthcare environment, there is a clear need for PhD prepared nurses who can lead in research, innovation and quality improvement as well as educating current and future generations of nurses. The Doctor of Philosophy (PhD) represents the highest level of education to pursue a career in research and scholarship and prepares nurses for careers in research, teaching or policy making. It also prepares them for leadership roles in diverse clinical and academic settings (American Association of Colleges of Nursing, 2010). PhD prepared nurses contribute to the development of nursing science and the discipline by identifying areas for research, conducting high quality research and implementing research findings into practice (de Lange et al., 2019; van Oostveen et al., 2017). Thereby PhD prepared nurses demonstrate unique expertise in research, innovative educational approaches, patient knowledge and political awareness (Broome, 2012).

PhD prepared nurses need to develop strong professional competencies to conduct research and contribute to the development of nursing science. Professional competencies are also needed to successfully navigate between the worlds of research, clinical practice and education (van Dongen & Hafsteinsdóttir, 2021). A competence can be 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 function (National Postdoctoral Association, 2002). It is assumed that during their doctoral education nurses acquire professional competencies and leadership skills, including how to lead in research, quality improvement projects, and higher education (American Association of Colleges of Nursing, 2010; Numminen et al.,

* Corresponding author at: Department of Nursing Science, Julius Center, Universiteitsweg 100, 3584 CG Utrecht, the Netherlands.
E-mail address: a.sterkenburg-2@umcutrecht.nl (A. Sterkenburg).

https://doi.org/10.1016/j.profnurs.2025.01.002
Received 16 May 2024; Received in revised form 6 January 2025; Accepted 7 January 2025
Available online 15 January 2025

2019; Weaver et al., 2023). They are also expected to have advocacy skills and seek new innovative approaches (Broome, 2015; van Dongen & Hafsteinsdóttir, 2021). However, it has been reported that PhD prepared nurses need to develop competencies after obtaining their doctorate (de Lange et al., 2019; Heinrich, 2005; McKenna, 2021; McMillian-Bohler & Tornwall, 2023; van Dongen, Hafsteinsdottir, et al., 2024; van Dongen & Hafsteinsdóttir, 2021).

Various global reports have called for stronger leadership of nurses across all levels of nursing as well as more leadership development opportunities (Ferguson et al., 2016; World Health Organization, 2020). Leadership is defined as a process whereby an individual influences a group of people to achieve a common goal (Northouse, 2018). To practice leadership, PhD prepared nurses need to develop wide range of competencies across the full spectrum of research, including the development of advocacy skills and having the courage to seek innovative solutions for challenges in healthcare (Broome, 2012). Leadership of nurses is associated with better patient outcomes including lower mortality rate, higher patient satisfaction and improved organizational outcomes (Cummings et al., 2018; van Dongen et al., 2021). It is known trough a recent study that leadership skills of nurses working in hospital wards was significantly associated with higher levels of quality of care (den Breejen-de Hooge et al., 2021). Although PhD prepared nurses show leadership in advancing nursing care by conducting interdisciplinary research and quality improvement projects, it is unknown how many PhD prepared nurses have access to opportunities to develop these leadership and mentoring competencies (de Lange et al., 2019; van Dongen & Hafsteinsdóttir, 2021).

There is growing interest in postdoctoral educational programs for nurses worldwide to support PhD prepared nurses in developing advanced professional competencies and skills to lead in solving our most pressing health care challenges. Through postdoctoral programs and fellowships, PhD prepared nurses can further their training as independent researchers, acquire a variety of competencies and skills, and increase their impact as leaders, educators, and researchers (Anderson et al., 2023; Hafsteinsdóttir et al., 2017). Among such initiatives is the Dutch 2-year Leadership and Mentoring in Nursing Research (LMNR) program for postdoctoral nurses which was found to positively influence the development of leadership and professional competencies and positively benefits research productivity and professional career development of the fellows participating in the program (Hafsteinsdóttir et al., 2020; van Dongen et al., 2021).

The Nurse-Lead program, conducted in a European collaboration, also showed that the participating doctoral nursing students and postdoctoral nurses improved their professional development and leadership skills, and supported them in establishing new international collaborative networks (van Dongen, Suidman, et al., 2024). A scoping review of empirical studies investigating professional competencies for postdoctoral researchers (Numminen et al., 2019). The review identified 15 competencies needed to develop a successful and sustainable research career for postdoctoral nurses: 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) pedagogical elements; 12) implementation of research results; 13) future visions; 14) technical competence and 15) intercultural competence (Appendix A) (Numminen et al., 2019). However, to what extent these competencies are actually expected from PhD prepared researchers may differ between countries and may depend on a wide range of factors like employment and career status of PhD prepared nurse researchers (Numminen et al., 2019).

Literature review

A study comparing international competency frameworks for registered nurses highlights the need for distinct competencies required in nursing, emphasizing the need for specialized frameworks that accurately reflect the profession's scope and responsibilities (Wit et al., 2023). The American Association of Colleges of Nursing (AACN) advocates for consistency in nursing education through a competency-based approach with standardized definitions tailored to the nursing profession (American Association of Colleges of Nursing, 2021).

In contrast, however, various frameworks for postdoctoral researchers in other fields emphasize broader, general competencies. The National Postdoctoral Association (NPA) and Johns Hopkins School of Medicine identify core competencies for postdoctoral researchers that are not tied to specific professions (Johns Hopkins School of Medicine, n. d.; National Postdoctoral Association, 2002). Similarly, the European Commission's European Charter for Researchers outlines general principles and requirements for researchers, focusing on their roles, responsibilities, and career development. (European Commission, 2005). These findings suggest that while general frameworks address a broad range of research competencies, nursing may require more tailored frameworks to meet its unique professional demands.

An instrument to measure the development of professional competencies is therefore expected to benefit not only the development of the required competencies but also the career development of PhD prepared nurses (Smaldone & Larson, 2021). This is not only important for the professional development of individual nurse researchers, but also to evaluate and monitor their academic development. Currently, no such instrument exists, and to address this gap this study takes the first steps toward its development.

The aim of this study was to reach consensus on professional competencies, develop an instrument to measure professional competencies of PhD prepared nurses and assess the content validity of the instrument, using a two-phased Delphi and validation method. In phase one the aim was to reach agreement between international nurse researchers on the importance of the previously determined PhD prepared nurse researchers' professional competencies using a Delphi study. In the second phase the aim was to determine content validity of these competencies once made into a self-assessment instrument using the Content Validity Index (CVI). A valid instrument to measure the professional competencies would not only benefit individual PhD prepared nurses in monitoring their individual academic development and career development, but assessment of the academic competencies also contributes to the monitoring of academic development of research groups of nursing science departments and faculties within universities, national and international.

Methods

Design

This study consisted of two phases. The first phase included a two-round Delphi study to reach agreement on the importance of the professional competencies and their definitions. A Delphi method was used to obtain agreement between a group of participants on a topic where knowledge is uncertain (Keeney et al., 2010). Afterwards a self-assessment instrument with the competencies was developed. In the second phase the content validity of the new instrument was determined by evaluating if the items of the instrument cover the complete range of the attribute under study (Devon et al., 2007). The method and results are reported following the ACcurate COnsensus Reporting Document (ACCORD) guidelines for Delphi studies (Gattrell et al., 2024).

Phase one

The first Delphi round focused on reaching agreement on the importance of the 15 professional competencies and the definitions as described in the scoping review (Numminen et al., 2019). A sample of PhD prepared nurses were asked to rate the importance of each competence and to rate to what extent they agreed with the definitions. Participants could suggest additional competencies and provide comments to refine the competencies and definitions. Data were used and

the 13 adjusted competencies and definitions were presented in the second round. The second Delphi round focused on reaching agreement between the participants on importance and accuracy of the definitions of the adjusted professional competencies. The competencies were then transferred into a self-assessment instrument to measure the professional competencies for PhD prepared nurse researchers.

Phase two

The content validity of the instrument was determined using the Content Validity Index (CVI) (Polit & Beck, 2006). The participants were asked to rate the competencies based on relevance for PhD prepared nurse researchers.

Study setting and sampling

The study population for both phases consisted of PhD prepared nurse researchers. The participants were from a wide range of countries with a minimum of five years of work experience after completing their PhD and fit in level 3 (*being an established independent researcher*) or 4 (*a researcher leading their research area or field*) of the European Framework for Research Careers profile levels according to their own assessment (European Commission, 2011). The European Framework for Research Careers provides a structure for different phases in a research career and was developed to enhance transparency and allow for comparison across labor markets in different sectors and countries (European Commission, 2011). The research team determined five years of working experience after obtaining their doctorate was required to ascertain that the participants would have sufficient experience and expertise to provide their perspectives on the professional competencies (McHugh & Lake, 2010).

For both phases participants were recruited through international collaboration networks of PhD prepared nurse researchers, nursing science organizations like the European Academy of Nursing Science, Sigma Theta Tau International and former participants of the educational programs Nurse-Lead and LMNR. In Delphi studies, a minimum of twelve participants is considered to be sufficient enough to reach consensus. A non-response rate of 20 % each round was to be expected (Santaguida et al., 2018). Therefore, in phase one, the aim was to include a minimum of 30 participants for the Delphi rounds. According to the CVI recommendations a sample size of eight to twelve participants was sufficient to determine the content validity (Polit et al., 2007). Therefore, in phase two, the aim was to include at least ten participants.

Invitations were sent to potential participants by a member of the research team (TBH) via email with participant information letters attached. Once a participant had indicated willingness to participate a second researcher (AS) provided a link to access the online questionnaire. After seven days automatic reminders were sent if the questionnaires were not completed. Participants had ten days to complete each questionnaire. Before the start of the data collection a pilot round was conducted with one participant to clarify the questions and to test the functionality of the digital questionnaire. No changes were made after the pilot round.

Data collection

Data was collected between March and May of 2023 using the online platform Castor EDC (Electronic Data Capture). Three questionnaires were sent to the participants, which included two for the Delphi rounds and one for the content validity. The questionnaires for the Delphi rounds focused on the participants level of agreement on importance of the professional competencies and their definitions which were measured on a four-point Likert scale. Importance of the competencies was scored from 1. 'not at all important' to 4. 'very important'. Agreement on the definitions was scored from 1. 'strongly disagree' to 4. 'strongly agree'. Participants were also invited to provide feedback on the definitions and to provide suggestions for adjustment in wording and additional competencies. Baseline characteristics of participants included demographic characteristics and years of research experience to determine diversity of the sample. The questionnaire for the content validity phase focused on the level of relevance of each of the competencies for PhD prepared nurse researchers measured on a four-point Likert scale ranging from 1. 'not at all relevant' to 4. 'highly relevant'.

Statistical analysis

The statistical analysis software SPSS (Statistical Package for the Social Sciences) version 26 was used. The analysis was conducted by the executive researcher (AS) and checked by two members of the research team (LvD, TBH). During the preparation and execution of the analysis a statistician was consulted.

Phase one

Descriptive statistics of baseline characteristics were described using frequencies and percentages. Data from the Likert scales were analyzed using frequencies and percentages, then frequencies on agreement were compared between each competence for each round. Independent samples *t*-tests and intraclass correlations coefficient (ICC two-way random, single measures on absolute agreement) were calculated to determine to what degree the changes made between the rounds influenced participants' opinions (Liljequist et al., 2019). Additionally, the feedback provided on the definitions was categorized per competence, and suggestions made for the adjustments were discussed within the research team before adaptations were made to the definitions.

Phase two

Descriptive statistics of baseline characteristics and Likert-scales outcomes were described using frequencies and percentages. The individual item and scale Content Validity Index of the new instrument was calculated. The index calculated for each individual item on the scale (I-CVI) was computed by the number of participants giving a rating of 3 or 4 ('quite relevant' or 'highly relevant') and dividing this number by the number of participants, creating a proportion in agreement about the relevance. The index calculated for the overall scale validity (S-CVI/Ave) was conducted by computing the I-CVI for each individual item on the scale and then calculating the average I-CVI across items. A S-CVI/Ave score of $\geq$0.80 would be considered valid (Polit et al., 2007).

Instrument construction

The two Delphi rounds resulted in the development of a self-assessment instrument, the Postdoctoral Nurses Competence Scale, to measure the professional competencies of PhD prepared nurse researchers. The instrument includes the competencies which can be rated on ten-point Likert scales, with scores ranging from 0. 'no level of competence' to 10. 'excellent level of competence' (Appendix D) (Texas A&M University Commerce, n.d.).

Ethical considerations

The study was conducted according to the principles of the Helsinki Declaration and the EU General Data Protection Regulation. A quality check was conducted by data managers of the university. All participants received the information letter prior to participating and signed a digital informed consent form before participating in this study.

Results

Characteristics of the sample

For phase one, the Delphi study, 45 international PhD prepared nurse researchers originating from 12 countries were invited to participate in both Delphi rounds, of whom 28 agreed to participate. For the first Delphi round 18 participants completed the questionnaires and for the

second Delphi round 13 participants completed the questionnaire. Invitations for the second round were only sent to those who completed the first round. The response rates for the Delphi study were respectively 64 % in the first round and 72 % in the second round. For the CVI phase, the 13 participants who completed the second Delphi round were invited to participate to determine content validity of whom nine participated, which resulted in a response rate of 69 % (Fig. 1).

Demographic characteristics

The participants were mostly female (77.8 %) and between 50 and 60 years of age. Half of the participants had a position as a professor (50 %), whereas other participants frequently held positions as associate- or assistant professor (16.7 % each). When asked about the participants main job tasks, more than half of the participants were involved in research work (55.6 %), and some combined this with work in education (16.7 %), or education and clinical practice (5.6 %). The PhD prepared nurses originated from twelve different countries across five continents with the majority of participants originating from Europe (72.2 %) (Table 1).

Phase 1: agreement on competencies and definitions

In the first Delphi round the participants valued the level of importance of four of the 15 competencies on a four-point Likert scale with a score of 'very' or 'fairly important'. These were the competencies 'management of research field', 'management of research ethics', 'cognitive competence' and 'management of team leadership'. Participants valued 13 of the 15 competencies with a score of either 'very', 'fairly' or 'somewhat important'. The 'competence of pedagogical elements' and the 'intercultural competence' were valued with a score of 'not at all important' by at least one or more participants. Participants scored six of the 15 definitions as 'strongly agree' or 'somewhat agree' whereas nine competencies received at least one 'strongly disagree' or 'somewhat disagree' rating (Table 2).

In round one, participants also provided feedback on the competencies and definitions (Appendix A). Feedback ranged from how broad a competence was described; "Does this include how to run a research project?" (competence of research field) to stating an opinion; "I think it is strange that a term from patient care is used for researchers" (competence of self-management). Based on the feedback the competencies and corresponding definitions were adjusted (Appendix B). The competencies of 'management of team working' and 'intercultural competence' and the competencies of 'management of team leadership' and 'future vision' were combined into two new competencies due to similarities and resemblances in the definitions, resulting in a total of 13 competencies with adjusted definitions (Appendix C).

In the second Delphi round participants scored eight of the 13 adjusted competencies 'very' or 'fairly important'. Participants valued all of the 13 competencies with a score of 'very', 'fairly' or 'somewhat important'. This means no competencies were considered 'not at all important'. Participants valued seven of the 13 definitions 'strongly' or

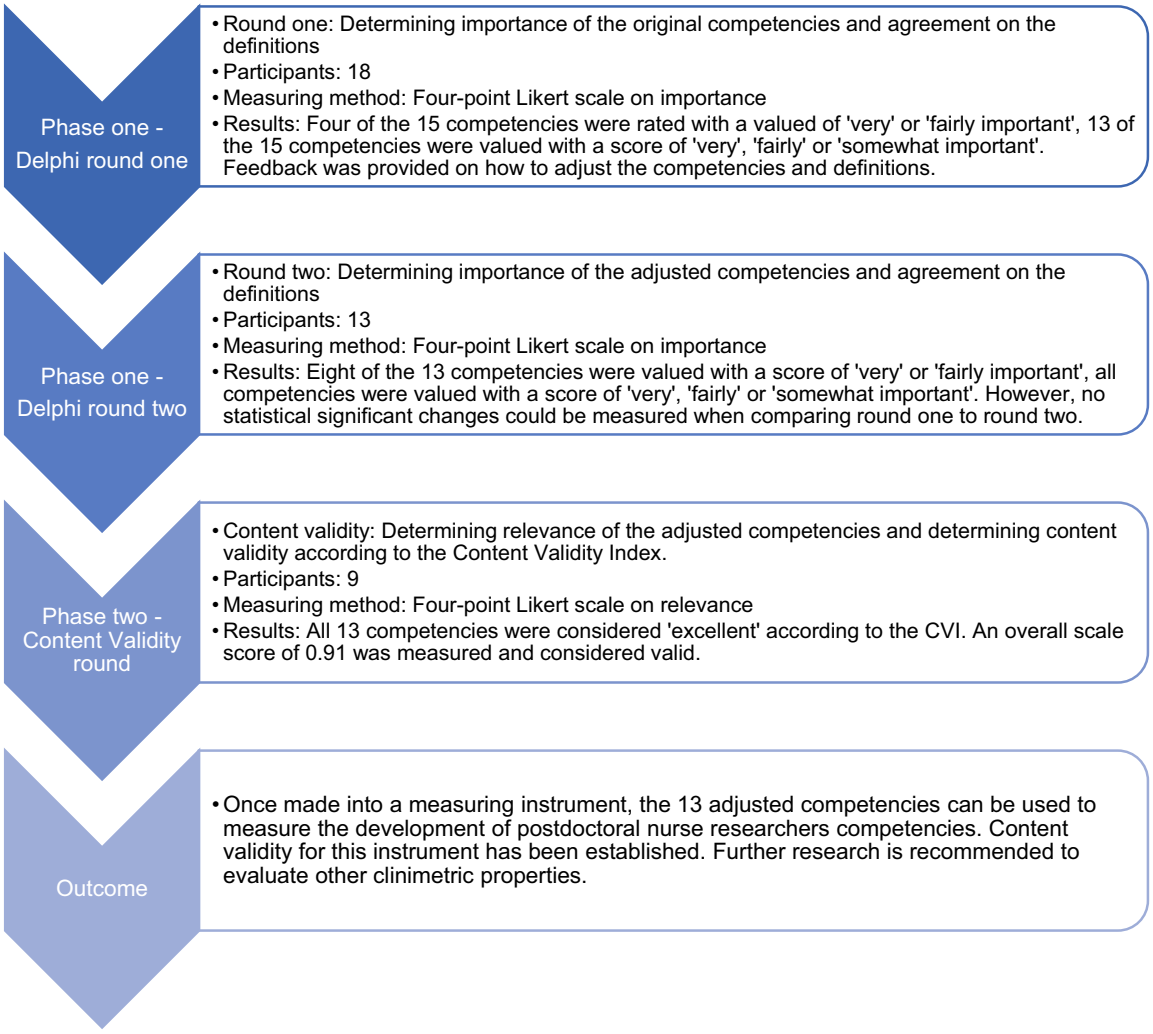

Fig. 1. Study design of the Delphi and Content Validity study for PhD prepared nurse researchers competencies.

Table 1
Characteristics of study participants.

	Delphi round 1 (*N* = 18)	Delphi round 2 (*N* = 13)	CVI round (*N* = 9)
Gender (N, %)			
Female	14 (77.8)	10 (76.9)	6 (66.7)
Male	4 (22.2)	3 (23.1)	3 (33.3)
Age group (N, %)			
30–39 years	1 (5.6)	–	–
40–49 years	5 (27.8)	5 (38.5)	2 (22.2)
50–60 years	7 (38.9)	4 (30.8)	3 (33.3)
>60 years	5 (27.8)	4 (30.8)	4 (44.4)
Country living and working in (N, %)			
Netherlands	5 (27.8)	3 (21.4)	1 (11.1)
Iceland	2 (11.1)	2 (14.3)	1 (11.1)
United Kingdom	2 (11.1)	2 (14.3)	2 (22.2)
Germany	1 (5.6)	–	–
Finland	1 (5.6)	–	–
Poland	1 (5.6)	1 (7.1)	1 (11.1)
Sweden	1 (5.6)	1 (7.1)	–
Israel	1 (5.6)	1 (7.1)	1 (11.1)
United States of America	1 (5.6)	1 (7.1)	1 (11.1)
Australia	1 (5.6)	1 (7.1)	1 (11.1)
Philippines	1 (5.6)	1 (7.1)	1 (11.1)
South Africa	1 (5.6)	–	–
Job position (N, %)			
Professor	9 (50)	5 (38.5)	4 (44.4)
Associate professor	3 (16.7)	3 (23.1)	1 (11.1)
Assistant professor	3 (16.7)	3 (23.1)	2 (22.2)
Postdoctoral researcher	1 (5.6)	–	–
Lecturer, Bachelor level	1 (5.6)	1 (7.7)	1 (11.1)
CEO	1 (5.6)	1 (7.7)	1 (11.1)
Main job tasks (N, %)			
Research	10 (55.6)	8 (61.5)	4 (44.4)
Education	3 (16.7)	1 (7.7)	2 (22.2)
Management	1 (5.6)	1 (7.7)	1 (11.1)
Research & education	3 (16.7)	2 (15.4)	2 (22.2)
Research, education & clinical practice	1 (5.6)	1 (7.7)	–
Time spend on research tasks (N, %)			
<25 % of worktime	2 (11.1)	2 (15.4)	2 (22.2)
25–50 % of work time	5 (27.8)	4 (30.8)	3 (33.3)
50–75 % of work time	7 (38.9)	6 (46.2)	2 (22.2)
>75 % of work time	4 (22.2)	1 (7.7)	2 (22.2)
PhD completed (N, %)			
5–10 years ago	5 (27.8)	4 (30.8)	2 (22.2)
11–15 years ago	5 (27.8)	5 (38.5)	4 (44.4)
>15 years ago	7 (38.9)	4 (30.8)	3 (33.3)
Not specified	1 (5.6)	–	–

'somewhat agree' and therefore six of the 13 competencies received at least one evaluation of 'strongly' or 'somewhat disagree' (Table 2).

When comparing Delphi rounds one and two, based on the number of competencies receiving only a 'very' or 'fairly important' rating, agreement between the participants seemed to have improved. No statistically significant changes were identified between the competencies and definitions when comparing the outcomes of the two rounds with an independent samples *t*-test, except the definition of intercultural team working which had a statistically significant improved rating with a *p*-value of 0.04. An intraclass correlation coefficient on the agreement between participants did not show an overall improvement on participants agreement between round one (ICC = 0.672) and two (ICC = 0.398).

Phase 2: content validity of the instrument

The participants valued four of the 13 adjusted competencies level of relevance on a four-point Likert scale with a score of 'highly relevant' or 'quite relevant', which were the competencies of 'research field', 'research skills', 'research ethics' and 'cognitive competence' (Table 3). Participants valued all 13 competencies with a score of either 'highly relevant', 'quite relevant' or 'somewhat relevant'. When computing the content validity index on item scale level (I-CVI) of the 13 competencies, four competencies reached 100 % relevance, seven competencies reached 89 % relevance and two competencies reached 78 % relevance. All item CVI scores were considered 'excellent'. The average score of the complete scale (S-CVI/Ave) was 0.91, indicating strong content validity.

Discussion

This two phase study reports on the development of a 13-item self-assessment instrument, the Postdoctoral Nurses Competence Scale (PNCS), for measuring professional competencies of PhD prepared nurse researchers. After the first Delphi round four of the 15 original competencies were rated with a score of 'very' or 'fairly important'. These were the competencies "management of research field", "management of research ethics", "cognitive competence" and "management of team leadership". After the second Delphi round eight of the 13 adjusted competencies were rated with a score of 'very' or 'fairly important'. The definitions of the competencies "research ethics" and "competence of self-management" received the poorest ratings. Feedback showed that not all participants agreed with the current approach of open science (recommendations and guidelines aiming to improve reproducibility, transparency and replicability in research (Hagger, 2022)) and, for some participants, the term 'self-management' was considered 'a patient-related term' not suitable for use in relation to healthcare professionals (Appendix C). Other feedback was mostly directed to unambiguous or unclear descriptions. Only one competence, 'intercultural team working', showed a statistically significant change between round one and two. However, as this is a newly created competence, combined of the two original competencies of 'management of team working' and 'intercultural management', the definition of this competence has had more alterations compared to other definitions.

Once made into an instrument, the 13-item instrument showed excellent content validity. However, other clinimetric properties such as an explanatory factor analysis and internal consistency still need to be evaluated before the PNCS can be used as a self-assessment for PhD prepared nurse researchers to measure their development and performance on the different competencies and monitor the academic progress of their research career (Devon et al., 2007; Yong & Pearce, 2013) In their scoping review, Numminen et al. (2019) stated: "*It would be helpful for the use of competencies in education and career development to have an agreement between international experts about the importance, relevance and categorization of required competencies*" (Numminen et al., 2019). This study shows that international PhD prepared nurse researchers with different nationalities and research oriented backgrounds state that the 13 adjusted competencies are relevant for the profession and the development of their career paths.

This study is, to our knowledge, the first to investigate professional competencies specifically tailored to PhD prepared nurse researchers, aiming to develop the PNCS, a self-assessment instrument. As stated in the introduction general competence frameworks already exist, like The National Postdoctoral Association and Johns Hopkins School of Medicine core competencies for postdoctoral researchers independent of professional backgrounds (Johns Hopkins School of Medicine, n.d.; National Postdoctoral Association, 2002). These core competencies include: 1) discipline-specific conceptual knowledge; 2) research skill development; 3) communication skills; 4) professionalism; 5) leadership and management skills and 6) responsible conduct of research (Johns Hopkins School of Medicine, n.d.; National Postdoctoral Association, 2002). Although phrased differently, the content of these six core competencies corresponds with the 13 competencies identified in this Delphi study and are included in the PNCS. 'Discipline-specific conceptual knowledge' of the NPA and Johns Hopkins is in line with the competencies of 'research field', 'research implementation' and 'technology' in our PNCS. 'Research skill development' of the NPA and Johns Hopkins matches the 'research skills' and 'cognitive competencies' of

Table 2
Delphi outcomes round one and two.

	Delphi round 1			*Delphi round 2*	
Competence 1:	Very important	15 (83.3)	*Competence 1:*	Very important	12 (92.3)
Management of research field	Fairly important	3 (16.7)	Competence of research field	Fairly important	1 (7.7)
	Somewhat important	–		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 1	Strongly agree	5 (27.8)	*Definition 1*	Strongly agree	6 (46.2)
	Somewhat agree	8 (44.4)		Somewhat agree	6 (46.2)
	Somewhat disagree	1 (5.6)		Somewhat disagree	1 (7.7)
	Strongly disagree	4 (22.2)		Strongly disagree	–
Competence 2:	Very important	16 (88.9)	*Competence 2:*	Very important	12 (92.3)
Management of research skills	Fairly important	1 (5.6)	Competence of research skills	Fairly important	1 (7.7)
	Somewhat important	1 (5.6)		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 2	Strongly agree	10 (55.6)	*Definition 2*	Strongly agree	8 (61.5)
	Somewhat agree	7 (38.9)		Somewhat agree	5 (38.5)
	Somewhat disagree	1 (5.6)		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 3:	Very important	17 (94.4)	*Competence 3:*	Very important	12 (92.3)
Management of research ethics	Fairly important	1 (5.6)	Competence of research ethics	Fairly important	1 (7.7)
	Somewhat important	–		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 3	Strongly agree	12 (66.7)	*Definition 3*	Strongly agree	9 (69.2)
	Somewhat agree	6 (33.3)		Somewhat agree	2 (15.4)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	2 (15.4)
Competence 4:	Very important	12 (66.7)	*Competence 4:*	Very important	10 (76.9)
Cognitive competence	Fairly important	6 (33.3)	Cognitive competence	Fairly important	3 (23.1)
	Somewhat important	–		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 4	Strongly agree	11 (61.1)	*Definition 4*	Strongly agree	9 (69.2)
	Somewhat agree	6 (33.3)		Somewhat agree	4 (30.8)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	1 (5.6)		Strongly disagree	–
Competence 5:	Very important	14 (77.8)	*Competence 5:*	Very important	11 (84.6)
Self-management	Fairly important	3 (16.7)	Competence of self-management	Fairly important	2 (15.4)
	Somewhat important	1 (5.6)		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 5	Strongly agree	12 (66.7)	*Definition 5*	Strongly agree	9 (69.2)
	Somewhat agree	5 (27.8)		Somewhat agree	3 (23.1)
	Somewhat disagree	1 (5.6)		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	1 (7.7)
Competence 6:	Very important	16 (88.9)	*Competence 6:*	Very important	10 (76.9)
Management of research communication	Fairly important	1 (5.6)	Research communication competence	Fairly important	3 (23.1)
	Somewhat important	1 (5.6)		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 6	Strongly agree	13 (72.2)	*Definition 6*	Strongly agree	9 (69.2)
	Somewhat agree	5 (27.8)		Somewhat agree	4 (30.8)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 7:	Very important	13 (72.2)	*Competence 7:*	Very important	8 (61.5)
Management of team working	Fairly important	4 (22.2)	Intercultural team working competence	Fairly important	5 (38.5)
	Somewhat important	1 (5.6)		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 7	Strongly agree	12 (66.7)	*Definition 7*	Strongly agree	12 (92.3)
	Somewhat agree	6 (33.3)		Somewhat agree	1 (7.7)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 8:	Very important	9 (50)	*Competence 8:*	Very important	10 (76.9)
Management of team leadership	Fairly important	9 (50)	Leadership competence	Fairly important	2 (15.4)
	Somewhat important	–		Somewhat important	1 (7.7)
	Not at all important	–		Not at all important	–
Definition 8	Strongly agree	14 (77.8)	*Definition 8*	Strongly agree	10 (76.9)
	Somewhat agree	4 (22.2)		Somewhat agree	3 (23.1)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 9:	Very important	10 (55.6)	*Competence 9:*	Very important	7 (53.8)
Management of resources	Fairly important	7 (38.9)	Financial and resource competence	Fairly important	3 (23.1)
	Somewhat important	1 (5.6)		Somewhat important	3 (23.1)
	Not at all important	–		Not at all important	–
Definition 9	Strongly agree	8 (44.4)	*Definition 9*	Strongly agree	7 (53.8)
	Somewhat agree	10 (55.6)		Somewhat agree	6 (46.2)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 10:	Very important	10 (55.6)	*Competence 10:*	Very important	7 (53.8)
Management of career	Fairly important	7 (38.9)	Academic career competence	Fairly important	5 (38.5)

(*continued on next page*)

Table 2 (*continued*)

	Delphi round 1			*Delphi round 2*	
	Somewhat important	1 (5.6)		Somewhat important	1 (7.7)
	Not at all important	–		Not at all important	–
Definition 10	Strongly agree	9 (50)	*Definition 10*	Strongly agree	9 (69.2)
	Somewhat agree	8 (44.4)		Somewhat agree	4 (30.8)
	Somewhat disagree	1 (5.6)		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 11:	Very important	9 (50)	*Competence 11:*	Very important	8 (61.5)
Pedagogical elements	Fairly important	5 (27.8)	Educational competence	Fairly important	3 (23.1)
	Somewhat important	3 (16.7)		Somewhat important	2 (15.4)
	Not at all important	1 (5.6)		Not at all important	–
Definition 11	Strongly agree	11 (61.1)	*Definition 11*	Strongly agree	7 (53.8)
	Somewhat agree	2 (11.1)		Somewhat agree	5 (38.5)
	Somewhat disagree	4 (22.2)		Somewhat disagree	1 (7.7)
	Strongly disagree	1 (5.6)		Strongly disagree	–
Competence 12:	Very important	10 (55.6)	*Competence 12:*	Very important	9 (69.2)
Management of the implementation of research results	Fairly important	6 (33.3)	Research implementation competence	Fairly important	4 (30.8)
	Somewhat important	2 (11.1)		Somewhat important	–
	Not at all important	–		Not at all important	–
Definition 12	Strongly agree	7 (38.9)	*Definition 12*	Strongly agree	9 (69.2)
	Somewhat agree	5 (27.8)		Somewhat agree	3 (23.1)
	Somewhat disagree	4 (22.2)		Somewhat disagree	1 (7.7)
	Strongly disagree	2 (11.1)		Strongly disagree	–
Competence 13:	Very important	9 (50)		Combined with competence 8	
Future visions	Fairly important	8 (44.4)			
	Somewhat important	1 (5.6)			
	Not at all important	–			
Definition 13	Strongly agree	12 (66.7)		Combined with competence 8	
	Somewhat agree	5 (27.8)			
	Somewhat disagree	–			
	Strongly disagree	1 (5.6)			
Competence 14:	Very important	5 (27.8)	*Competence 13:* Technology competence	Very important	5 (38.5)
Management of technology	Fairly important	8 (44.4)		Fairly important	6 (46.2)
	Somewhat important	5 (27.8)		Somewhat important	2 (15.4)
	Not at all important	–		Not at all important	–
Definition 14	Strongly agree	8 (44.4)	*Definition 13*	Strongly agree	5 (38.5)
	Somewhat agree	10 (55.6)		Somewhat agree	8 (61.5)
	Somewhat disagree	–		Somewhat disagree	–
	Strongly disagree	–		Strongly disagree	–
Competence 15:	Very important	13 (72.2)		Combined with competence 7	
Intercultural competence	Fairly important	2 (11.1)			
	Somewhat important	2 (11.1)			
	Not at all important	1 (5.6)			
Definition 15	Strongly agree	9 (50)		Combined with competence 7	
	Somewhat agree	7 (38.9)			
	Somewhat disagree	1 (5.6)			
	Strongly disagree	1 (5.6)			

*Corresponding definitions can be found in appendix A and B.

the PNCS. 'Communication skills' matches the 'research communication', 'academic career' and 'educational competencies'. 'Professionalism' corresponds with the 'competence of self-management'. 'Leadership and management skills' matches the 'leadership', 'intercultural team working' and 'financial and resource competencies'. Finally 'responsible conduct of research' of the NPA and Johns Hopkins corresponds with the competence of 'research ethics' in the PNCS. Concluding that all 13 competencies of the PNCS are in line with the six core competencies of the NPA and Johns Hopkins. However, the 13 competencies for PhD prepared nurse researchers identified in this study are more specified and detailed whereas the aforementioned six core competencies are described from a broader and more general perspective. The 13 competencies identified and validated in this study can provide a more detailed direction on specific areas for PhD prepared nurses to improve their academic competencies and their research career development compared to the more general core competencies of the NPA and Johns Hopkins.

The general principles and requirements from the European Charter for Researchers, developed by the European Commission, specifies the roles, responsibilities and entitlements of researchers. The aim of the Charter is to ensure that the nature of the relationship between researchers and employers or funders is conducive to successful performance in generating, transferring, sharing and disseminating knowledge and technological development, and to the career development of researchers (European Commission, 2005). These principles include: 'research freedom', 'ethical principles', 'professional responsibility', 'professional attitude', 'contractual and legal obligations', 'accountability', 'good practice in research', 'dissemination and exploitation of results', 'relation with supervisors', 'supervision and managerial duties' and 'continuing professional development' (European Commission, 2005). These guiding principles are also corresponding with the 13 competencies of the PNCS. In a similar way, European Council of Doctoral Candidates and Junior Researchers identified 17 joint transferable skills and competencies relevant for early career researchers to gather during their doctoral training program and beyond, to increase their employability and include, among others, the following competence categories: 'career development', 'cognitive', 'communication', 'digital', 'enterprise', 'interpersonal', 'mobility' and 'research' (European Council of Doctoral Candidates and Junior Researchers, 2018). These transferable competencies are also generally in line with the 13 competencies the PNCS identified and validated in this study and included in the PNCS.

A need has been expressed for specialized nursing frameworks to accurately reflect the profession's scope and responsibilities (Wit et al., 2023) and for a competency-based approach in nursing education advocating for standard definitions and competencies tailored

Table 3
Content Validity Index of the competencies.

Competence	*Relevance level*	*N*	*I-CVI score*
Competence 1: Competence of research field	Highly relevant	8 (88.9)	Score: 9/9
	Quite relevant	1 (11.1)	I-CVI: 1.00
	Somewhat relevant	–	Evaluation: Excellent
	Not at all relevant	–	
Competence 2: Competence of research skills	Highly relevant	8 (88.9)	Score: 9/9
	Quite relevant	1 (11.1)	I-CVI: 1.00
	Somewhat relevant	–	Evaluation: Excellent
	Not at all relevant	–	
Competence 3: Competence of research ethics	Highly relevant	9 (100)	Score: 9/9
	Quite relevant	–	I-CVI: 1.00
	Somewhat relevant	–	Evaluation: Excellent
	Not at all relevant	–	
Competence 4: Cognitive competence	Highly relevant	5 (55.6)	Score: 9/9
	Quite relevant	4 (44.4)	I-CVI: 1.00
	Somewhat relevant	–	Evaluation: Excellent
	Not at all relevant	–	
Competence 5: Competence of self-management	Highly relevant	6 (66.7)	Score: 8/9
	Quite relevant	2 (22.2)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	
Competence 6: Research communication competence	Highly relevant	7 (77.8)	Score: 8/9
	Quite relevant	1 (11.1)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	
Competence 7: Intercultural team working competence	Highly relevant	4 (44.4)	Score: 8/9
	Quite relevant	4 (44.4)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	
Competence 8: Leadership competence	Highly relevant	4 (44.4)	Score: 8/9
	Quite relevant	4 (44.4)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	
Competence 9: Financial and resource competence	Highly relevant	3 (33.3)	Score: 7/9
	Quite relevant	4 (44.4)	I-CVI: 0.78
	Somewhat relevant	2 (22.2)	Evaluation: Excellent
	Not at all relevant	–	
Competence 10: Academic career competence	Highly relevant	6 (66.7)	Score: 8/9
	Quite relevant	2 (22.2)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	
Competence 11: Educational competence	Highly relevant	5 (55.6)	Score: 7/9
	Quite relevant	2 (22.2)	I-CVI: 0.78
	Somewhat relevant	2 (22.2)	Evaluation: Excellent
	Not at all relevant	–	
Competence 12: Research implementation competence	Highly relevant	6 (66.7)	Score: 8/9
	Quite relevant	2 (22.2)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	
Competence 13: Technology competence	Highly relevant	3 (33.3)	Score: 8/9
	Quite relevant	5 (55.6)	I-CVI: 0.89
	Somewhat relevant	1 (11.1)	Evaluation: Excellent
	Not at all relevant	–	

specifically to nursing (American Association of Colleges of Nursing, 2021). After further validation, the PNCS can be an instrument for measuring nurse-specific competencies in a consistent manner, aligned with predetermined competencies and definitions.

An instrument to measure professional competencies is not only relevant to measure professional development, but could also serve educational and research purposes. Traditionally, educational programs as well as professional leadership and mentoring programs often rely on satisfaction surveys or mentor ratings. While useful to provide some insight in course effectiveness, these methods, are not suitable to measure professional development (Steen et al., 2021). A newly developed curriculum for postdoctoral fellows on leadership and management showed that more structured (self-) assessments focusing on self-perceived knowledge and growth can lead to increased awareness and confidence (Steen et al., 2021). Increased awareness contributes to better conceptual understanding and therefore allows learners to review and reconstruct their understanding of a particular skill. These skills have traditionally been difficult to measure, but a self-rating method could serve as a reliable proxy, according to the new postdoctoral curriculum (Steen et al., 2021). In addition to utilizing the PNCS during educational programs, the self-assessment results could also serve to evaluate the outcomes and impact of these programs, addressing the current lack of nursing-specific instruments for measuring such outcomes (Hafsteinsdóttir et al., 2017). Using the PNCS as a self-assessment instrument to measure the development of professional competencies of PhD prepared nurses could therefore be beneficial in a variety of settings.

Limitations of the study

Limitations of this study relate to the sample size and the diversity of the sample. The preferred sample size of 20 international participants per round for the first phase, and 10 for the second phase, was not reached (Polit et al., 2007; Santaguida et al., 2018). Nonetheless, both study phases exceeded the minimum required number of participants to provide sufficient information and feedback for refining the competencies (Polit et al., 2007; Santaguida et al., 2018). The recruitment method, which relied on professional networks, may have introduced

network bias by favoring well-connected PhD prepared researchers who are part of research communities. This approach potentially excluded individuals outside these circles who might offer different experiences, perspectives, or competencies. Sampling bias could also have arisen, as participants were primarily drawn from groups accessible to the research team which might have contributed to the overrepresentation of European researchers in the participant group. While the study successfully included participants from five continents, participation was primarily from European countries, limiting the representation of participants views from other regions. Larger sample sizes and additional study rounds, as typically seen in Delphi studies, could have enabled broader inclusion of PhD prepared nurses globally. To fully capture international perspectives on professional competencies, incorporating more participants from outside Europe remains important.

Participants feedback indicated that there was still room for improvement on the descriptions of the competencies and their definitions. However, an a-priori prefixed two rounds for this Delphi was chosen to reach agreement with international PhD prepared nurse researchers, in line with Delphi recommendations (Boulkedid et al., 2011). No statistically significant changes were measured with a sampled *t*-test when comparing the mean outcomes of rounds one and two. Also, the intraclass correlation coefficient showed no improvement on overall agreement when comparing both rounds. Part of this is most likely due to the small sample size and narrow Likert scale outcome range. Both analysis methods are originally designed for continues variables where for this study ordinal outcomes were measured. Even with that discrepancy these were still considered the best methods to measure statistical changes after consulting a statistician. In order to measure a significant change in outcomes, a larger sample size would be needed. Interestingly enough, even without complete agreement an excellent grading was measured when computing the Content Validity. However, improving agreement among participants on all competencies and definitions is still desired.

Future studies could continue and expand the current Delphi study by including more international participants, extend the number of Delphi rounds and possibly include focus group meetings for extracting additional information to improve the competence list for PhD prepared nurse researchers (Dijkstra et al., 2021; Polit et al., 2007; Santaguida et al., 2018).

Implications for the nursing science

The self-assessment instrument, incorporating 13 adjusted competencies, demonstrated strong content validity, resulting in the development of the PNCS. While further validation testing is required, the instrument offers practical benefits. After further validation it can be used by nurse researchers to monitor their progress in developing specific competencies over time, with the flexibility to reassess periodically. Based on a ten-point Likert scale, ranging from 0 (“no level of competence – no experience in the skill area”) to 10 (“excellent level of competence – extensive experience in the skill area”) (Texas A&M University Commerce, n.d.), the instrument is also valuable for raising awareness about the key competencies required after completing a PhD program. This awareness can guide PhD students and recent graduates to focus on developing the skills needed for a successful doctoral research career. Additionally, the tool can be employed to measure outcomes of mentoring programs designed for PhD prepared nurse researchers, providing a structured approach to competency development and career progression.

Conclusion

This study comprises the first step in the development of the Postdoctoral Nurses Competence Scale to measure professional competencies of PhD prepared nurse researchers. After two Delphi rounds determining the importance of the competencies and their definitions the outcomes were considered acceptable. The content validity on relevance of the PNCS was found to be ‘excellent’. Even though content validity is established, further research is recommended to evaluate other clinimetric properties of the PNCS in order to use the self-assessment instrument to measure competence development.

CRediT authorship contribution statement

Annika Sterkenburg: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Lisa J.C. van Dongen:** Writing – review & editing, Validation, Methodology, Investigation, Conceptualization. **Thóra B. Hafsteinsdóttir:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Investigation.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

Acknowledgement

The authors would like to thank the participants for participating in this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.profnurs.2025.01.002.

Data availability

Data are available from the corresponding author on reasonable request.

References

American Association of Colleges of Nursing. (2010). *The research-focused doctoral program in nursing: Pathways to excellence*.

American Association of Colleges of Nursing. (2021). *The essentials: Core competencies for professional nursing education*.

Anderson, C. M., Ardery, N., Pesut, D., Alvarez, C., Gray, T. F., Rose, K. M., … Wright, K. D. (2023). Nurse scholars of the Robert Wood Johnson Foundation Harold Amos Medical Faculty Development Program. *Nursing Outlook, 71*(5). https://doi.org/10.1016/j.outlook.2023.102027

Boulkedid, R., Abdoul, H., Loustau, M., Sibony, O., & Alberti, C. (2011). Using and reporting the Delphi method for selecting healthcare quality indicators: A systematic review. *PLoS One, 6*(6). https://doi.org/10.1371/journal.pone.0020476

Broome, M. E. (2012). Doubling the number of doctorally prepared nurses. *Nursing Outlook, 60*(3), 111–113.e1. https://doi.org/10.1016/j.outlook.2012.04.001

Broome, M. E. (2015). Leadership in science. *Nursing Science Quarterly, 28*(2), 164–166. https://doi.org/10.1177/0894318415571610

Cummings, G. G., Tate, K., Lee, S., Wong, C. A., Paananen, T., Micaroni, S. P. M., & Chatterjee, G. E. (2018). Leadership styles and outcome patterns for the nursing workforce and work environment: A systematic review. *International Journal of Nursing Studies, 85*(March), 19–60. https://doi.org/10.1016/j.ijnurstu.2018.04.016

de Lange, W., Kars, M. C., Poslawsky, I. E., Schuurmans, M. J., & Hafsteinsdóttir, T. B. (2019). Postdoctoral nurses’ experiences with leadership and career development: A qualitative study. *Journal of Nursing Scholarship, 51*(6), 689–698. https://doi.org/10.1111/jnu.12519

den Breejen-de Hooge, L. E., van Os-Medendorp, H., & Hafsteinsdóttir, T. B. (2021). Is leadership of nurses associated with nurse-reported quality of care? A cross-sectional survey. *Journal of Research in Nursing, 26*(1–2), 118–132. https://doi.org/10.1177/1744987120976176

Devon, H. A., Block, M. E., Moyle-Wright, P., Ernst, D. M., Hayden, S. J., Lazzara, D. J., … Kostas-Polston, E. (2007). A psychometric toolbox for testing validity and reliability. *Journal of Nursing Scholarship, 39*(2), 155–164. https://doi.org/10.1111/j.1547-5069.2007.00161.x

Dijkstra, N. E., De Baetselier, E., Dilles, T., Van Rompaey, B., da Cunha Batalha, L. M., Filov, I., … Sino, C. G. M. (2021). Developing a competence framework for nurses in pharmaceutical care: A Delphi study. *Nurse Education Today, 104*(August). https://doi.org/10.1016/j.nedt.2021.104926

European Commission. (2005). *The European charter for researchers*.

European Commission. (2011). *European commission: Towards a European Framework for Research Careers. 2010* pp. 1–11) (July).

European Council of Doctoral Candidates and Junior Researchers. (2018). *Identifying transferable skills and competences to enhance early-career researchers employability and competitiveness*.

Ferguson, S. L., Al Rifai, F., Maay'a, M., Nguyen, L. B., Qureshi, K., Tse, A. M., … Jeadrik, G. (2016). The ICN leadership for change programme - 20 years of growing influence. *International Nursing Review, 63*(1), 15–25. https://doi.org/10.1111/inr.12248

Gattrell, W. T., Logullo, P., van Zuuren, E. J., Price, A., Hughes, E. L., Blazey, P., … Harrison, N. (2024). ACCORD (ACcurate COnsensus Reporting Document): A reporting guideline for consensus methods in biomedicine developed via a modified Delphi. *PLoS Medicine, 21*(1). https://doi.org/10.1371/journal.pmed.1004326

Hafsteinsdóttir, T. B., Schoonhoven, L., Hamers, J., & Schuurmans, M. J. (2020). The leadership mentoring in nursing research program for postdoctoral nurses: A development paper. *Journal of Nursing Scholarship, 52*(4), 435–445. https://doi.org/10.1111/jnu.12565

Hafsteinsdóttir, T. B., van der Zwaag, A. M., & Schuurmans, M. J. (2017). Leadership mentoring in nursing research, career development and scholarly productivity: A systematic review. *International Journal of Nursing Studies, 75*(November 2016), 21–34. https://doi.org/10.1016/j.ijnurstu.2017.07.004

Hagger, M. S. (2022). Developing an open science 'mindset'. In , *Vol. 10, Issue 1. Health Psychology and behavioral medicine* (pp. 1–21). Taylor and Francis Ltd.. https://doi.org/10.1080/21642850.2021.2012474

Heinrich, K. T. (2005). Halfway between receiving and giving: A relational analysis of doctorate-prepared nurse–scholars' first 5 years after graduation. *Journal of Professional Nursing, 21*(5), 303–313. https://doi.org/10.1016/j.profnurs.2005.07.004

Johns Hopkins School of Medicine. (n.d.). Core competencies for postdoctoral research fellows. Retrieved May 17, 2023, from https://www.hopkinsmedicine.org/som/offices/pda/training-resources/core-competencies.html.

Keeney, S., Hasson, F., & McKenna, H. (2010). The Delphi technique in nursing and health research. *Wiley-Blackwell.*. https://doi.org/10.1002/9781444392029

Liljequist, D., Elfving, B., & Roaldsen, K. S. (2019). Intraclass correlation – A discussion and demonstration of basic features. *PLoS One, 14*(7). https://doi.org/10.1371/journal.pone.0219854

McHugh, M. D., & Lake, E. T. (2010). Understanding clinical expertise: Nurse education, experience, and the hospital context. *Research in Nursing & Health, 33*(4), 276–287. https://doi.org/10.1002/nur.20388

McKenna, H. (2021). Postdoctoral nurse researchers: The ups and downs of their roles, functions and careers. *International Journal of Nursing Studies, 118*. https://doi.org/10.1016/j.ijnurstu.2021.103885

McMillian-Bohler, J., & Tornwall, J. (2023). Trends, future directions, and questions for preparing successful nurse faculty. *Journal of Nursing Education, 62*(12), 661–667. https://doi.org/10.3928/01484834-20231006-06

National Postdoctoral Association. (2002). NPA core competencies. https://www.nationalpostdoc.org/page/CoreCompetencies.

Northouse, P. G. (2018). *Leadership: Theory and practice* (8th ed.). SAGE publications.

Numminen, O., Virtanen, H., Hafsteinsdóttir, T., & Leino-Kilpi, H. (2019). Postdoctoral nursing researcher career: A scoping review of required competences. *Nursing Open, 7*(1), 7–29. https://doi.org/10.1002/nop2.367

Polit, D. F., & Beck, C. T. (2006). The Content Validity Index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health, 29*, 489–497. https://doi.org/10.1002/nur

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Focus on research methods. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health, 30*, 459–467. https://doi.org/10.1002/nur

Santaguida, P., Dolovich, L., Oliver, D., Lamarche, L., Gilsing, A., Griffith, L. E., … Raina, P. (2018). Protocol for a Delphi consensus exercise to identify a core set of criteria for selecting health related outcome measures (HROM) to be used in primary health care. *BMC Family Practice, 19*(1), 1–14. https://doi.org/10.1186/s12875-018-0831-5

Smaldone, A., & Larson, E. L. (2021). What PhD competencies should guide the preparation of nurse scientists? *Journal of Professional Nursing, 37*(1), 201–203. https://doi.org/10.1016/j.profnurs.2020.06.010

Steen, K., Vornhagen, J., Weinberg, Z. Y., Boulanger-Bertolus, J., Rao, A., Gardner, M. E., & Subramanian, S. (2021). A structured professional development curriculum for postdoctoral fellows leads to recognized knowledge growth. *PLoS One, 16*(11 November), 1–18. https://doi.org/10.1371/journal.pone.0260212

Texas A&M University Commerce. (n.d.). Self-assessment of skill level. Retrieved May 5, 2023, from https://inside.tamuc.edu/academics/colleges/educationhumanservices/departments/socialwork/documents/self-evaluation-scale.pdf.

van Dongen, L., Cardiff, S., Kluijtmans, M., Schoonhoven, L., Hamers, J. P. H., Schuurmans, M. J., & Hafsteinsdóttir, T. B. (2021). Developing leadership in postdoctoral nurses: A longitudinal mixed-methods study. *Nursing Outlook, 69*(4), 550–564. https://doi.org/10.1016/j.outlook.2021.01.014

van Dongen, L., Hafsteinsdottir, T. B., Broome, M. E., Suhonen, R., & Leino-Kilpi, H. (2024). Career development of doctorally prepared nurses. *Journal of Advanced Nursing, 80*(3), 854–870. https://doi.org/10.1111/jan.15847

van Dongen, L., Suidman, L., Henriques, M. A., Jónsdóttir, H., Leino-Kilpi, H., Luderer, C., … Hafsteinsdóttir, T. B. (2024). Improved professional competencies and leadership in PhD-prepared nurses and doctoral students after participating in the cross-national and web-based nurse-Lead program. *Nursing Outlook, 72*(2), Article 102144. https://doi.org/10.1016/j.outlook.2024.102144

van Dongen, L. J. C., & Hafsteinsdóttir, T. B. (2021). Leadership of PhD-prepared nurses working in hospitals and its influence on career development: A qualitative study. *Journal of Clinical Nursing*, 1–14. https://doi.org/10.1111/jocn.16168. November.

van Oostveen, C. J., Goedhart, N. S., Francke, A. L., & Vermeulen, H. (2017). Combining clinical practice and academic work in nursing: A qualitative study about perceived importance, facilitators and barriers regarding clinical academic careers for nurses in university hospitals. *Journal of Clinical Nursing, 26*, 4973–4984. https://doi.org/10.1111/jocn.13996

Weaver, T. E., Lott, S., McMullen, P., Leaver, C. A., Zangaro, G., & Rosseter, R. (2023). Research focused doctoral nursing education in the 21st century: Curriculum, evaluation, and postdoctoral considerations. *Journal of Professional Nursing, 44*, 38–53. https://doi.org/10.1016/j.profnurs.2022.11.001

Wit, R. F., de Veer, A. J. E., Batenburg, R. S., & Francke, A. L. (2023). International comparison of professional competency frameworks for nurses: A document analysis. *BMC Nursing, 22*(1), 343. https://doi.org/10.1186/s12912-023-01514-3

World Health Organization. (2020). State of the world's nursing 2020: Investing in education, jobs and leadership. https://www.icn.ch/resources/publications-and-reports/state-worlds-nursing-report-2020.

Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorial in Quantitative Methods for Psychology, 9*(2), 79–94. https://doi.org/10.20982/tqmp.09.2.p079