www.ijres.net

Development and Psychometric Testing of the Health Sciences Generic Competence (HealthGenericCom) Instrument: A Cross-sectional Study

Sari Pramila-Savukoski, Heli-Maria Kuivila, Jonna Juntunen, Miro Koskenranta, Erika Jarva
University of Oulu, Finland

Anna-Maria Tuomikoski
Oulu University Hospital, Finland

Mira Hammarén, Kristina Mikkonen
University of Oulu, Finland

To cite this article:

Pramila-Savukoski, S., Kuivila, H., Juntunen, J., Koskenranta, M., Jarva, E., Tuomikoski, A., Hammarén, M., & Mikkonen, K. (2024). Development and psychometric testing of the Health Sciences Generic Competence (HealthGenericCom) Instrument: A cross-sectional study. *International Journal of Research in Education and Science (IJRES), 10*(1), 21-45. https://doi.org/10.46328/ijres.3306

IJRES International Journal of Research in Education and Science
2024, Vol. 10, No. 1, 21-45 https://doi.org/10.46328/ijres.3306

Development and Psychometric Testing of the Health Sciences Generic Competence (HealthGenericCom) Instrument: A Cross-sectional Study

Sari Pramila-Savukoski, Heli-Maria Kuivila, Jonna Juntunen, Miro Koskenranta, Erika Jarva, Anna-Maria Tuomikoski, Mira Hammarén, Kristina Mikkonen

Article Info

Article History

Received:
30 June 2023
Accepted:
11 October 2023

Keywords

Generic competence
Health sciences
Instrument
Psychometric testing
Student

Abstract

There is a clear need for highly competent health sciences experts. No instrument currently exists for assessing the generic competences of health sciences students. The aim of this study is to develop and psychometrically test the Health sciences Generic Competence (HealthGenericCom) instrument. The instrument development four step process has been conducted with a cross-sectional study design and according to the COSMIN guidelines. Face and content validity was tested by 13 experts, structural validity was tested with exploratory factor analysis, and internal consistency was evaluated by calculating Cronbach's alpha. The structural validity was tested using data from Finnish health sciences students (n=276). The content validity index of the whole HealthGenericCom instrument was 1 for relevance and for clarity. Using exploratory factor analysis a model of eight factors (with 88 items) was created: 1) competence in leadership, administration, and finance; 2) competence in people-centred guidance; 3) competence in health promotion; 4) competence in evidence-based practice; 5) digital competence; 6) competence in work well-being and self-management; 7) competence in collaboration and problem-solving; and 8) competence in societal interaction. The HealthGenericCom was shown to be valid and reliable and provides an evidence-based conceptual framework that can be used in developing curriculums and competence management.

Introduction

Health care workers across different organisational levels play vital roles in actions that enhance the quality of care (European Union, 2022; World Health Organization, 2022). However, the current economic situation can be expected to exacerbate health care workforce shortages and workloads (Legido-Quigley et al., 2020). As such, there is a clear need for highly competent social and health care experts who can develop evidence-based care, lead, solve multidimensional problems, effectively collaborate, and leverage people-centric digital solutions (WHO, 2022). Health sciences higher education will provide this kind of competence. To reach a certain level of health care, countries around the world have started to define minimum standards for the different generic competences that working life demands (Langins & Borgermans, 2015). These are e.g., communication, collaboration, critical thinking, problem-solving skills (Binkley et al., 2012; Tuononen et al., 2022; var Laar et

al., 2020) and human-centeredness and leadership skills (Al Jabri et al., 2021). Higher education is crucial for developing an individual's work-related generic competence (European Union (EU), 2018).

Several instruments for measuring the core competences of healthcare professionals, and/or educators exist, yet there is lack of an instrument that measures generic competences that are relevant to the health sciences experts. Assessing the generic competences that are relevant to health sciences will be important for developing the curricula and helping students to be conscious about various competence areas. By using it systematically, educators can monitor the development of students' competences or needs during their studies. Thus, an instrument could be advantageous to the development of high-quality education and evaluation of which competences can be improved through continuous learning of the students. It can be also used among experts in working places for the purpose of competence management.

Background

Competence can be understood as a holistic concept that covers gaining the knowledge, skills, attitudes, and values needed to meet complex demands (Organisation for Economic Co-operation and Development, 2018). Lately, more emphasis has been placed on the general competences, yet this is a complex concept with several parallel definitions (Chan et al., 2017; Tuononen et al., 2022). The concept of generic competence has been used interchangeably with the concepts of employability skills, transferable skills, and graduate attributes (Chan et al., 2017). Also 21st century skills; cognitive and metacognitive skills, social and emotional skills (Binkley et al., 2012; var Laar et al., 2020) have been used to describe the general skills that are useful in future work. The development of generic competence has been identified as the key which links students with working life (Balderas et al., 2018; National Research Council, 2013). Generally, European Qualification Framework (EQF) defines competence as possessing certain knowledge, skills, and responsibilities (EU, 2017), along with generic attributes, capabilities, and social skills (which can be developed by obtaining certain degrees). However, the EQF does not explicitly describe which competences are expected from certain degrees.

Health science experts can pursue a Bachelor's, Master's or Doctoral degree; e.g. health sciences Bachelor's degree is equivalent to a nursing degree (EQF level 6) but does not lead to a professional qualification rather than expertise in developing the social and health sector. Learning and developing general competences during education paves the way for high-quality healthcare (Langins & Borgermans, 2015). Generic competence areas which are relevant to the health sciences field have been identified in recent years (Al Jabri et al., 2021, Pramila-Savukoski et al., 2022). One of the areas is competence in leadership and administration, which comprises the skills needed to manage personal activities, multiprofessional teams, and financial tasks when developing client-oriented care (Al Jabri et al., 2021; Heinen et al., 2019; Pramila-Savukoski et al., 2022). Second, decision-making, interaction, resource management, as well as enabling and managing change are important skills for leaders (Kakemam et al., 2020). Today, health care services need to be people-centred, which means that health care workers need to be able to identify client needs and provided individualised services; moreover, multidisciplinary teams must also be capable of working in a people-centred way (Al Jabri et al., 2021; Kitson et al., 2012; Pramila-Savukoski et al., 2022), considering clients' rights, and adhering to ethical guidelines (Koskenvuori et al., 2019).

Health sciences experts work in interprofessional teams. Interprofessional collaboration promotes coordination and access to health services, as well as reduces health care costs (Brandt et al., 2014). It also improves care quality, maintains patient safety, and promotes general health in the population (WHO, 2010).

The overall aim of social and health care should be developing the health and well-being of the general populations. As such, health care experts need to be competent at developing, understanding, and assessing health promotion (Pramila-Savukoski et al., 2022; WHO, 2019). This means that health sciences experts need competence in evidence-based health care, which includes generating knowledge, assessing the reliability of research data, applying different methods, as well as implementing the latest evidence (Jordan et al., 2019; Pramila-Savukoski et al., 2022; Al Jabri et al., 2021). Digitalisation has recently become prevalent in all sectors of society, that demands digital competence. In healthcare context, digital competence involves the ability to design people-centered digital services in a secure way, to interact with digital services, to guide customers and to help the work community develop the use of digital services (European Union, 2022, European Commission, 2016; Nazeha et al., 2020; Pramila-Savukoski et al., 2022; Strudwick et al., 2019), and to act ethically in digital environments (Brice & Almond, 2020; Nazeha et al., 2020).

Generic competence also includes skills related to work and self-management, such as assessing development goals, prioritising tasks, and planning approaches for achieving goals (Maenda & Socha-Dietrich, 2021; OECD, 2018). Collaboration and problem-solving competence have been identified as generic skills (Al Jabri et al., 2021; Maenda & Socha-Dietrich, 2021; Pramila- Savukoski et al., 2022). A health sciences expert should have ability to network with other professionals, participate in social debates (Eskola et al., 2022), and communication (EU, 2017; Skarbaliene et al., 2019). Regarding generic competence instruments, the systematic review by Al Jabri et al. (2021) describes the characteristics and psychometric properties of instruments that have been designed to assess health care professionals' core competences in clinical settings (e.g., professionalism, ethical and skills, evidence-based practice, teamwork and collaboration, leadership and management, patient-centred care, quality improvement and technology). The Nurse Competence Scale (Flinkman et al., 2017; Meretoja et al., 2004) and Clinical Nurse Specialist Core Competency Scale (Jokiniemi et al., 2021) are examples of instruments that were developed to measure core competences among health care workers. Furthermore, other instruments have been developed to measure nurse managers' leadership and management competences (Kantanen et al., 2015), along with health care professionals' evidence-based practice skills (Albarqouni et al., 2018; Haavisto et al., 2022). In the educational field, several instruments are used for the self-assessment of educators' competence in education (e.g. Mikkonen et al., 2020). Based on our knowledge, no instrument for the self-evaluation of health sciences students' and experts' generic competence currently exists.

Methods

Aims

The aim of the study was to develop and psychometrically test the Health sciences Generic Competence (HealthGenericCom) instrument, which was designed as a tool for the self-evaluation of generic competence in health sciences (equivalent to EQF 6 level). The research questions were:

1. What is the face and content validity of the HealthGenericCom instrument?;
2. What is the structural validity of the HealthGenericCom instrument?; and
3. What is the internal consistency of the HealthGenericCom instrument?

Design

The instrument development process was conducted according to COSMIN guidelines (Mokkink et al., 2010), and employed a cross-sectional study design. The STROBE checklist (Von Elm et al., 2007) was used to enhance the validity of the research.

Participants

The participants were health sciences Bachelor's or Master's degree students from five different universities in Finland. In this study, health sciences students are defined as students who are completing their Bachelor's degree in health sciences (nursing science or health management), public health, gerontology, health education, health promotion, sports medicine, or nutrition, as well as Master's degree students enrolled in health sciences teacher education, nursing science or health management, gerontology, public health, health education, health promotion, physiotherapy, sports medicine, and nutrition. The inclusion criteria were:

1) the student was studying health sciences in a Bachelor's or Master's degree programme; and
2) the student was willing to participate in the study.

The necessary sample size was estimated based on the suggestion that there should be at least three participants per item (n=279) to reliably conduct instrument structural validation and assess internal consistency (Knapp & Brown, 1995; Pett et al., 2003). The purposive sampling method was used. A total of 291 health sciences students (N=1400) responded. For the psychometrical testing of the instrument, univariate and multivariate outliers have been removed (n=15), which means that data from 276 participants were used to measure the validity and reliability of the instrument.

Instrument Development

The instrument development process involved (I) establishing a theoretical background, (II) testing face and content validity, (III) assessing structural validity, and (IV) evaluating internal consistency (see Figure 1). The HealthGenericCom instrument consists of 88 items across eight sub-dimensions which respondents score using a five-point Likert scale:

1–poor
2–moderate
3–good
4–very good
5–excellent

A neutral score option was omitted to provide a more accurate self-assessment of competence.

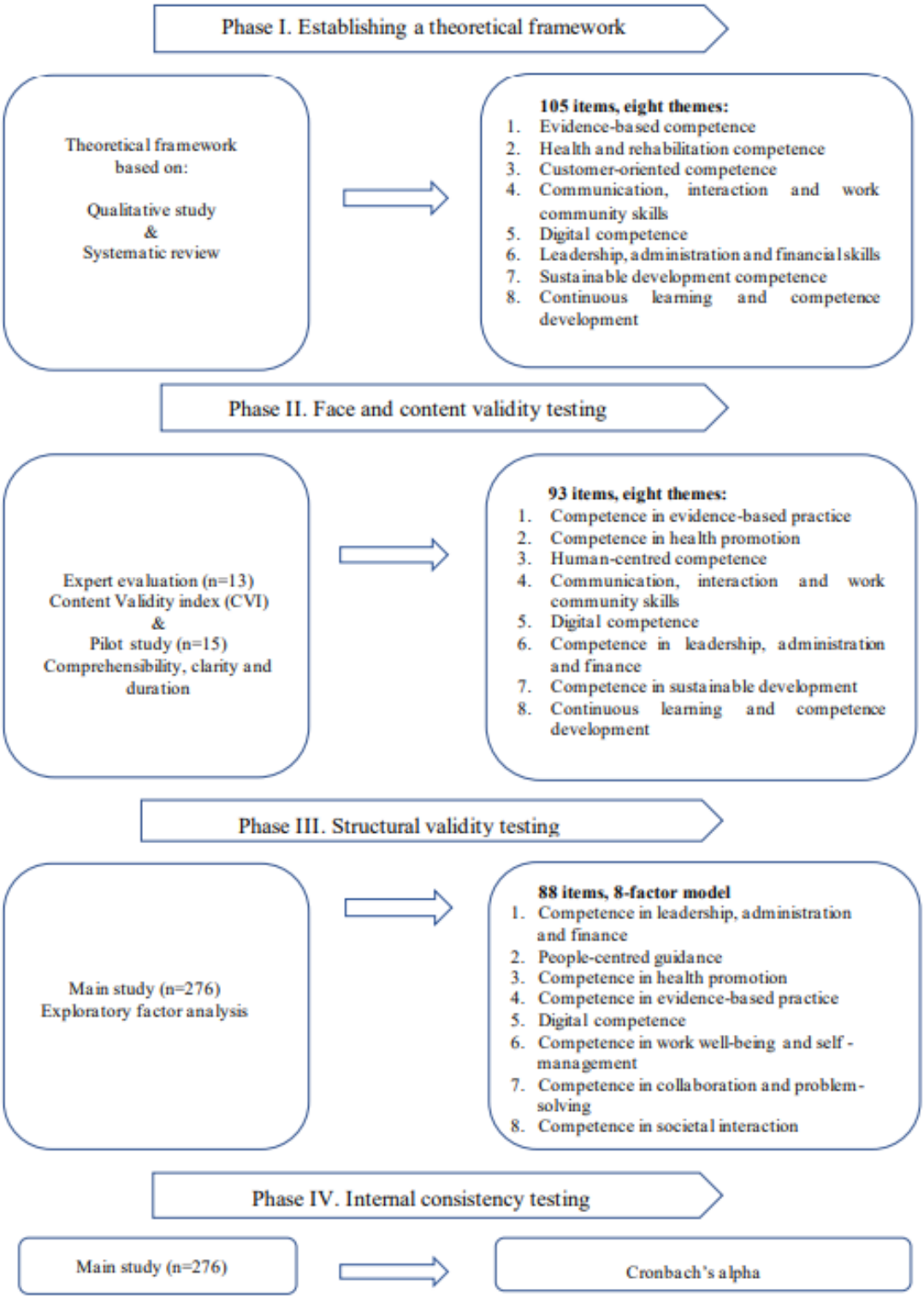

Figure 1. The Instrument Development and Testing Process

Phase I - Theoretical Framework for the Instrument

The theoretical background for the items was developed based on a systematic review of existing instruments for measuring health care professionals' core competences (Al Jabri et al., 2021) and a qualitative study concerning health sciences students' experiences of health sciences competence development (Pramila-Savukoski et al.,

2022). The initial version of the instrument included a total of 105 items and eight categories (Figure 1).

Phase II – Face and Content Validity Testing

In the second phase, face and content validity were tested and validated through an expert panel (DeVellis, 2017). A total of 13 experts were recruited, of which 11 represented university teachers, principal lecturers, university lecturers, researchers, clinical nursing science experts and two second-year Bachelor's degree students. Inclusion criteria for recruiting experts was understanding about health sciences field and expertise. The content validity was measured by calculating the Content Validity Index, which comprised both an individual item evaluation (I-CVI) and overall instrument validation (S-CVI/Ave) (Polit & Beck, 2021). The items were rated for relevance and clarity (Polit et al., 2007). The limit for an acceptable I-CVI score was set as ≥ 0.78 for each item, while the corresponding cutoff for S-CVI/Ave was 0.80-1.00 (Polit et al., 2007). Face validity was tested using the expert panel to ascertain whether the items were understandable and had a logical flow. The instrument was pilot tested with 15 health sciences students to assess the comprehensibility and clarity of items, as well as how long it took to answer the instrument.

Phase III – Structural Validity Testing

The structural validity of the instrument (including 93 items) was tested with exploratory factor analysis (EFA), which included Principal Axis Factoring and Promax rotation. Promax rotation was chosen based on factors correlation more than 0.2 (Pett et al., 2003). Univariate and multivariate outliers were identified with Mahalanobis distances and Mardia's kurtosis index, with the p-value threshold set at <0.001; any identified outliers were removed so as not to distort subsequent analyses, which strengthens the structural validity of an instrument (Mikkonen et al., 2022; Munro, 2005). The Kaiser-Mayer-Olkin (KMO) test and Bartlett's test of Sphericity (BTS) were used to evaluate sampling adequacy. A KMO test score of >0.60 indicates an unacceptable size (Yong & Pearce, 2013). The cut-off for removing an item was set at <0.30, while the number of factors was estimated by counting the number of eigenvalues <1 (Yong & Pearce, 2013). EFA was guided by the process for establishing the theoretical framework. All of the analyses were performed in IBM SPSS Statistics software (V27.0, IBM Corporation, Armonk, NY).

Phase IV – Assessment of Internal Consistency

Internal consistency was evaluated by calculating Cronbach's alpha values. According to the literature, values ≥0.70 are adequate for a newly developed instrument, values above 0.80 are acceptable for a well-established instrument, and values over 0.90 are needed for an instrument that is used in the clinical setting to be reliable (DeVon et al., 2007).

Data Collection

The Webropol online survey system (V3.0, Webropol, Helsinki, Finland) was used for data collection during the

spring 2022. A contact person at each university sent students (N=1400) an invitation email three times over two weeks. Participants were informed about the study aims, and methods. The response rate was 20.7% (n=291). The questionnaire included 11 background questions and 93 items of the HealthGenericCom instrument. The background questions concerned the respondents' age, gender, educational background, graduation year for the highest degree, degree level, amount of ECTS credits completed, participation in national conferences, continuing education, research or developing projects, work-based practical training in social and health care sector (minimum of 5 ECTS), years of work experience in social and health care, and the position(s) in which the participant has worked.

Ethical Considerations

Each organisation involved in the study has given research permission to conduct the study. The study did not require ethical permission, as the research did not violate the integrity of the participants, the data were not used without informed consent, participants were not under 18 years of age, and there was no security threat to the participants (Declaration of Helsinki, 2013; Medical Research Act, 1999/488). All of the participants were treated with respect for privacy and humanity (Declaration of Helsinki, 2013).

The participants received information about the voluntary study beforehand and they had the right to withdraw at any phase (Finnish National Board on Research Integrity TENK, 2019). The data were protected in a password-protected file on a locked computer, with only the researchers having access. The latest legislative guidelines for data availability and protection (Data Protection Act 1050/2018, General Data Protection Regulation, 2018) were adhered to.

Results

Participant Characteristics

Data representing 276 health sciences students were used in this study (see Table 1). The mean age of the students was 34 years and most of them were female (90.2%, n=249). Over half of the participants (52.5%, n=145) had a Bachelor’s degree from a university of applied sciences as their educational background, while nearly a quarter (24.3%, n=67) had a Bachelor’s degree from a university. The average graduation year for the most recent degree was 2015, and over half of the participants (67.4%, n=186) were Master’s degree students. The students had completed between 0 to 330 ECTS (mean 111 ECTS), during their studies.

The European Credit Transfer and Accumulation System (ECTS) is a tool of the European Higher Education Area for making studies and courses more transparent; e.g. Bachelor's degree consists of 90-120 ECTs (European Commission, 2015). The majority of the students (77.2%, n=213) hadn’t participated in national conferences, continuing education, research or developing projects during their studies, and hadn’t completed a 5 ECTS work-based practical training course in social and health care (63.4%, n=175). The participants had an average of nine years of work experience in social and health care, with most participants having worked as healthcare professionals (67.4%).

Table 1. Characteristics of the Participants (n=276)

Characteristic	**Participants**
Age	
Mean (SD)	33.94 (8.57) years
Minimum (Min.)	20 years
Maximum (Max.)	63 years
Gender, n (%)	
Male	25 (9.1%)
Female	249 (90.2%)
Other	2 (0.7%)
Educational background, n (%)	
Vocational education	5 (1.8%)
Baccalaureate degree	27 (9.8%)
Double degree (vocational+ baccalaureate)	2 (0.7%)
Bachelor's degree from university	67 (24.3%)
Bachelor's degree from university of applied sciences	145 (52.5%)
Master's degree from university	13 (4.7%)
Master's degree from university of applied sciences	17 (6.2%)
Graduation year of the highest degree, mean (SD)	2015 (6.37) year
Degree level, n (%)	
Bachelor's degree	90 (32.6%)
Master's degree	186 (67.4%)
ECTS completed	
Mean (SD)	111.07 ECTs (68.41 ECTs)
Minimum (Min.)	0.0 ECTs
Maximum (Max.)	330.0 ECTs
Participating in national conferences, continuing education, research or developing projects, n (%)	
No	213 (77.2%)
Yes	63 (22.8%)
Work-based practical training in social- and health care sector (minimum 5 ECTS), n (%)	
No	175 (63.4%)
Yes	101 (36.6%)
Work experience in social- and health care, in years	
Mean (SD)	8.7 years (7.2 years)
Minimum (Min.)	0.0 years
Maximum (Max.)	36.9 years

Characteristic	Participants
Work experience in social- and health care, position, n (%)	
No experience	34 (12.3%)
Practical training experience	2 (0.7%)
Social- and health care professionals' job	186 (67.4%)
Various experience from social- and health care professional positions and other expert positions	40 (14.5%)
Experience other than a social- and health care job, e.g., project leader	9 (3.3%)
Management expert position	5 (1.8%)

HealthGenericCom Instrument

The results are presented according to the four phases of the instrument development process: (I) establishing a theoretical background; (II) testing face and content validity; (III) assessing structural validity; and (IV) evaluating internal consistency (Figure 1).

Phase I - Theoretical Framework

The theoretical background, which was based on themes identified in a previous systematic review of instruments for measuring health care workers' core competences (Al Jabri et al., 2021) and qualitative research about students' experiences of health sciences competence development (Pramila-Savukoski et al., 2022), was used to develop the instrument. The systematic review was conducted to examine the characteristics and psychometric properties of existing instruments for measuring health professionals' core competences in clinical work. Al Jabri et al. (2021), described nine instruments that measured the following competence themes: professionalism; ethical and legal issues; research and evidence-based practice; personal and professional development; teamwork and collaboration; leadership and management; and patient-centred care. Competence related to quality improvement, safety, communication, and health information technology were included in a few instruments. Another study, performed by Pramila-Savukoski et al. (2022), revealed six distinct health sciences competence areas: management of current scientific knowledge; theoretical knowledge of health sciences; critical thinking skills; communication and interaction skills; leadership and management skills; and ethical skills. Items were carefully generated based on the qualitative study and analysis categories of Pramila-Savukoski et al. (2022) and competence areas of systematic review (Al Jabri et al., 2021). The initial version of the HealthGenericCom instrument included 105 items across eight competence areas, namely, 1) Evidence-based competence, 2) Health and rehabilitation competence, 3) Customer-oriented competence, 4) Communication, interaction, and work community skills, 5) Digital competence, 6) Leadership, administration and financial skills, 7) Sustainable development competence, and 8) Continuous learning and competence development (Figure 1).

Phase II - Face and Content Validity Testing

The instrument was evaluated by a panel of health sciences experts. I-CVI was calculated by dividing the number

of experts who had given higher scores (scores 3 or 4) by the total number of experts to gauge the relevance and clarity of items. The expert evaluations yielded varying I-CVI results: two items received a value of 0.75 for relevance and four items received a score of 0.75 for clarity. Rest 101 items received I-CVI values 0.83-1. S-CVI/Ave, which was calculated, was 0.92 for relevance and 0.96 for clarity of the instrument. After this, four items were deleted due the low value. One item was modified. Totally 101 items were left, but relating to expert comments, 10 items had similarity with other items so those were removed. Two new items were developed. The new expert evaluation was done. All items received I-CVI scores between 0.83 to 1 for relevance and for clarity. S-CVI/Ave was 1 for relevance and 1 for clarity of the instrument. A total of 93 items were selected for testing structural validity. The themes in the second version of the HealthGenericCom instrument were: 1) Competence in evidence-based practice; 2) Competence in health promotion; 3) Human-centred competence; 4) Communication, interaction, and work community skills; 5) Digital competence; 6) Competence in leadership, administration, and finance; 7) Competence in sustainable development; and 8) Continuous learning and competence development. No changes were made after pilot testing.

Phase III - Assessment of Structural Validity

The structural validity of the instrument was tested using data from health sciences students (n=276). All 93 items were tested with EFA, after which low-loading and cross-loaded items were removed (n=5). The Kaiser-Mayer-Olkin measure (0.944) demonstrated that the data were suitable for factor analysis, while the Bartlett's Test of Sphericity result (x2= 21914.691, df=4278, p <0.001) was also acceptable. After 10 tests of different factor models, an eight-factor model including 88 items, which explained 62% of the total variance, was found to be theoretically and statistically suitable (see Table 2). Only loadings ≥0.300 are presented in the table 2. The first factor, *Competence in leadership, administration and finance* (14 items), explained 36.53% of total variance (eigenvalue 36.99). The second factor, *Competence in people-centred guidance* (17 items), explained 4.62% of total variance (eigenvalue 5.00); the third factor, *Competence in health promotion* (10-items), explained 4.36% of total variance (eigenvalue 4.84); the fourth factor, *Competence in evidence-based practice* (12 items), explained 3.49% of total variance (eigenvalue 3.93); the fifth factor, *Digital competence* (10 items), explained 3.04% of total variance (eigenvalue 3.51); the sixth factor, *Competence in work well-being and self-management* (9 items), explained 2.70% of total variance (eigenvalue 3.17); the seventh factor, *Competence in collaboration and problem-solving* (8 items), explained 1.95% of total variance (eigenvalue 2.45); and the eighth factor, *Competence in societal interaction* (8 items), explained 1.56% of total variance (eigenvalue 2.07).

Table 2. Exploratory Factor Analysis of the HealthGenericCom Instrument (n=276)

Factor (F)		Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
Competence in leadership, administration and finance	1.	I can lead the activities of social- and healthcare services in a client-oriented manner	0.871							
	2.	I can take multidisciplinary expertise into account	0.865							

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
	when leading a group								
	3. I can lead a group in a goal-oriented way	0.807							
	4. I can take economic aspects (including costs) into account in my actions	0.801							
	5. I can enable conditions (e.g. induction, working hours) for professionals to perform their duties	0.785							
	6. I can handle administrative matters related to my work (e.g. employment matters, organisational decision-making)	0.784							
	7. I can utilise networks in leadership	0.729							
	8. I can evaluate how economic and societal (e.g. political) changes influence an organisation	0.725							
	9. I can organise the tasks of others (e.g. members of my work community)	0.577							
	10. I can renew social and health services in an innovative way	0.482							
	11. I can develop the multi-professional work environment	0.428							
	12. I can identify the strengths of members of my work community	0.412							
	13. I can utilise my work experience when developing practices	0.397							
	14. I can promote change through my own actions	0.364							
Competence in people-centred	15. I can guide clients in the social- and health care system		0.833						

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
guiding	16. I can interact with the client		0.824						
	17. I can face the client individually		0.809						
	18. I can take the client's resources into account in my actions		0.762						
	19. I can cooperate with the clients' relatives		0.757						
	20. I can anticipate potential risks to clients in the social- and health care system		0.679						
	21. I can take the client's expectations into account in my actions		0.656						
	22. I can take the ethical and legal rights of my clients into account		0.634						
	23. I can involve the clients in the planning of their care		0.631						
	24. I can describe the actions of the social- and health care system		0.597						
	25. I can take the needs of clients of different ages into account when organising services		0.584						
	26. I can act in accordance with relevant laws and regulations (including national policy models/guidelines)		0.531						
	27. I can take cultural diversity into account in my activities (e.g. during client encounters and service planning)		0.426						
	28. I can use different client-oriented methods (e.g. service design) in the development of services		0.406						

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
	29. I can utilise the special expertise of social and health operators		0.380						
	30. I can take ethical aspects (including data protection) into account when encountering clients and planning service planning		0.346						
	31. I can work as part of a multidisciplinary work community		0.305						
Competence in health promotion	32. I can define what it means to promote health from the individual perspective			0.859					
	33. I can define ways to promote the health of the population			0.828					
	34. I can define the significance of health promotion for society			0.820					
	35. I can evaluate the factors that affect the health of the population			0.816					
	36. I can evaluate what health as a concept means from the individual perspective			0.813					
	37. I can recognise the importance of the health of the population			0.781					
	38. I can evaluate what the concept of well-being means from the individual perspective			0.751					
	39. I can evaluate what health as a concept means from the societal perspective			0.736					
	40. I can identify the factors related to an individual's well-being			0.721					

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
	41. I can design methods for promoting health in society			0.545					
Competence of evidence-based practice	42. I can justify the importance of evidence-based information and research in the development of a high-quality social- and health service system				0.783				
	43. I can structure the process of evidence-based practice (searching for evidence, implementing the evidence-based information and ensuring the implementation of evidence-based information)				0.747				
	44. I can act as a disseminator of evidence (e.g. clinical guidelines, systematic reviews) in situations such as meetings, education, and my work community				0.728				
	45. I can supervise members of the work community to critically evaluate their own activities in evidence-based practices				0.716				
	46. I can supervise members of the work community to critically evaluate their working activities in evidence-based practices				0.713				
	47. I can explain the concept of evidence				0.711				
	48. I read scientific publications to develop my own competence				0.710				
	49. I can make decisions based on evidence and				0.707				

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
	expert knowledge								
	50. I can apply different research methods in evidence-based practices				0.698				
	51. I can independently search research/evidence data from the most common databases (e.g. PubMed. CINAHL. Medline)				0.693				
	52. I can critically evaluate the work community's activities in evidence-based practices				0.680				
	53. I can critically evaluate the most important factors related to the reliability of research				0.583				
Digital competence	54. I can design new client-oriented digital services for social and health care					0.818			
	55. I can design digital services in a client-safe way					0.808			
	56. I can interact with the clients' digital services (e.g. electronic services)					0.807			
	57. I can guide the members of my work community in developing digital services					0.794			
	58. I can apply digital solutions (e.g. devices, applications, electronic transactions) in the development of social- and health care services					0.752			
	59. I can guide clients in the use of digital services (e.g. electronic self-care services)					0.716			
	60. I can market the introduced digital social					0.701			

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
	and health services for the clients								
	61. I can identify the principles and possibilities of use regarding artificial intelligence and robotics in social- and health care					0.636			
	62. I can evaluate the client's ability to use digital services (e.g. electronic self-care services)					0.621			
	63. I can act ethically in digital environments. e.g. take into account the client's privacy					0.545			
Competence in work well-being and self-management	64. I can take care of my well-being at work						0.678		
	65. I can identify my own areas of development						0.676		
	66. I can set development goals for myself						0.637		
	67. I can plan how I use my time						0.636		
	68. I can prioritise my own tasks						0.623		
	69. I can evaluate my own activities						0.614		
	70. I can set different time frame goals for my action						0.455		
	71. I can systematically move towards my development goals						0.420		
	72. I can apply the principles of sustainable development (e.g. responsibility, consideration of natural resources) in the social- and health care system						0.338		
Competence in collaboration	73. I can take into account the different perspectives of members of my work							0.716	

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
and problem-	community								
solving	74. I can act constructively in situations of conflict							0.682	
	75. I am open to receiving feedback in my work							0.595	
	76. I can give constructive feedback							0.588	
	77. I can solve problems in cooperation with others							0.574	
	78. I can share my knowledge with members of my work community							0.389	
	79. I can independently solve problems in my own work							0.386	
	80. I can guide members of my work community to develop their competence							0.309	
Competence	81. I can work as an expert								0.673
in societal	in global networks								
interaction	82. I can utilise different national networks in my actions								0.668
	83. I can influence work through social impact, for example, by participating in a social debate as an expert of health sciences								0.570
	84. I can communicate in an accessible way (according to the EU Accessibility Directive)								0.432
	85. I can evaluate the significance of global change (e.g. climate change, global policies) for the social- and health care system								0.422
	86. I can communicate verbally through different communication channels								0.348
	87. I can follow current social issues to support								0.328

Factor (F)	Item	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
	my expertise								
	88. I can communicate in writing through different communication channels								0.318
Eigenvalue		36.994	5.000	4.842	3.938	3.519	3.178	2.456	2.073
Percentage of variance explained		36.532	4.621	4.363	3.491	3.049	2.700	1.953	1.562
Total percentage of variance explained by the factor model									62.001
Cronbach's alpha		0.94	0.94	0.95	0.93	0.92	0.88	0.90	0.85
Cronbach's alpha for total scale									0.98

Phase IV – Evaluation of Internal Consistency

In Phase IV, internal consistency was measured by calculating Cronbach's alpha values. The values for the items ranged from 0.85 to 0.95; more detailed descriptions can be found in Table 2.

Discussion

The aim of this study was to develop and psychometrically test the HealthGenericCom instrument, which was created as a tool for health sciences students and experts to self-evaluate their generic competence. Although there is a European framework for determining the level of qualification based on knowledge, skills, and responsibilities (EU, 2017), there is no previous research on the generic competence of health sciences students and/or experts.

Al Jabri et al. (2021) reviewed the instruments that can be used to assess health professionals' core competences and classified certain core competences, e.g., professionalism, the ability to deliver care according to legal and ethical practices, evidence-based practices, personal development, teamwork, collaboration and patient-centredness. Health sciences experts work as leaders, educators, or experts who promote healthcare services and evidence-based decision-making. Patient-centredness is a part of several instruments, for example, the Nurse Competence Scale (Meretoja et al., 2004), which measures registered nurses' competence at different career phases and contains themes related to patient care (individual needs, ethical point of view, managing situations, and ensuring quality). Moreover, the Clinical Nurse Specialist Core Competency Scale (Jokiniemi et al., 2021)

was developed so that nurses with advanced or specialised roles could self-evaluate their organisational, patient, scholarship, and nursing competence.

Moreover, Kantanen et al. (2015) developed an instrument to assess both general and specific competences among leaders; in this instrument, general competence involves factors such as professionalism, communication, resilience, ethical skills, service initiation, evidence-based practices, and personal commitment. Some of the instruments developed for healthcare professionals include evidence-based competence (Albarqouni et al., 2018; Haavisto et al., 2022). For instance, the instrument developed by Mikkonen et al. (2022) to evaluate health sciences educators' competence includes evidence-based competence, along with pedagogical competence. Regarding generic competence in education, Tuononen et al. (2022) identified 17 distinct generic competence areas, while Strijbos et al. (2015) reviewed the most common generic competences, as well as the associated interconnections, at the Bachelor's degree level. Nevertheless, there is still a lack of instruments and theoretical understanding about generic competence among various health sciences experts.

HealthGenericCom was carefully validated. The factors demonstrated a high level of reliability, with Cronbach's alpha values ranging from 0.85-0.95. The first factor, Competence in leadership, administration and finance (14 items), explained 36.53% of total variance and is thus an essential part of the instrument. Most of the items (17 in total) were loaded to the second factor, Competence in people-centred guidance. The work of health sciences experts is demanding and, as such, requires various competences. The instrument development process revealed that, in addition to leadership, administration and finance skills and a people-centred approach, health sciences experts must be skilled at evidence-based practice, the use of digital technology, work well-being and self-management, collaboration and problem-solving, and engaging in societal interactions. Managing the processes involved in social and health care services, leading people (Kakemam et al., 2020), and facilitating the conditions necessary for people-centred care are relevant competences for leaders (Heinen et al., 2019). Moreover, health sciences experts are competent at sharing the latest evidence at the workplace (Jordan et al., 2019).

Our instrument helps to provide framework for monitoring the development of students' competences or needs during their studies. There is a need to design educational practices so that experts can meet societal needs, such as supporting citizens' possibilities for social equality (Haddington et al., 2021) and well-being (Maenda & Socha-Dietrich, 2021). The current nature of work means that health sciences experts should be competent at promoting a wide range of health activities (Pramila-Savukoski et al., 2022; WHO, 2019), as well as able to manage their own activities and work well-being by identifying areas of development, setting goals, and prioritising tasks (Heinen et al., 2019). Collaboration with multiprofessional and interprofessional teams is essential for a sustainable digital future and working life (Haddington et al., 2021), and a key part of this competence is sharing knowledge by participating in social debates (Eskola et al., 2022) in both national and international events.

The definition of generic competence remains fragmented, with various definitions existing in the literature (OECD, 2018; Strijbos et al., 2018: Tuononen et al., 2022). The EQF (EU, 2017) describes which qualifications should be obtained when completing a certain degree, but doesn't define health sciences competences. For this reason, Tuononen et al. (2022) stated that the concept of generic competence requires coherent theorisation and

operationalisation. Furthermore, specific instruments are necessary for assessing and promoting health sciences students' and experts' generic competence. The HealthGenericCom instrument fills this obvious gap. Evaluating generic competences both among health sciences students and at the workplace is critical to maintaining a high standard of social and health care services (Langins & Borgermans, 2015). The HealthGenericCom instrument is beneficial not only individuals and developing education (curriculums), but also leaders and managers who are responsible for competence development in organisations. It helps developing e.g. continuous education. The HealthGenericCom was translated into English utilising forward-backward method, but the instrument should be further tested in other cultural contexts.

Limitations and Strengths

This study involves certain limitations. First, the response rate was around 20%, and a larger sample or larger amount of Bachelor´s degree students may have provided different results. Nevertheless, the study sample ensured the minimum of three participant responses per item which was required to conduct structural validation and internal consistency testing (Knapp & Brown, 1995). The performed analyses provide empirical evidence for the reliability of the HealthGenericCom instrument.

The results may have been influenced or biased by the background of the respondents. Half of the students were social and health professionals, with an average of 9 years of work experience, but had not done a work placement while studying to become an expert. The strengths of the instrument were theoretical framework, content validity evaluation, face validity and the pilot testing. As the presented instrument involves self-assessment, additional studies involving educators and experts are needed to determine the utility of the instrument in different organisations. To increase the validity of study's process, developing the instrument, the COSMIN guidelines (Mokkink et al., 2010) and The STROBE checklist (Von Elm et al., 2007) was used.

Conclusions

Evaluating generic health sciences competences is important for the development of education, the assessment of continuous health sciences learning and ensuring high-quality care. The newly developed HealthGenericCom instrument is valid and reliable and can be used as an evidence-based theoretical framework to guide curriculum construction. In this case, this could be used in longitudinal research in which the effect of multiple educational interventions could be measured to highlight effective ways of teaching. It can be translated into different languages to increase utilisation on an international level. This instrument is useful not only for educational policy developers, but also relevant for experts who want to assess and build the competences necessary for providing high-quality social and health care. It is also useful in competence management and organisational leadership.

Acknowledgements

We appreciate all the health sciences students for their time and participating in this study. We would like to acknowledge Sees-Editing Ltd (http://www.seesediting.co.uk) service for finishing the language.

References

Al Jabri, Y. M. F., Kvist, T., Azimirad, M., & Turunen, H. (2021). A systematic review of healthcare professionals' core competency instruments. *Nursing & Health Sciences. 23*, 87–102. http://doi.org/10.1111/nhs.12804

Albarqouni, L., Hoffmann, T., Straus, S., Olsen, N. R., Young, T., Ilic, D., Shaneyfelt, T., Haynes, R. B., Gyuatt, G. & Glasziou, P. (2018). Core competencies in evidence-based practice for health professionals: Consensus statement based on a systematic review and delphi survey. *JAMA Network Open, 1*(2), e180281. https://doi.org/10.1001/jamanetworkopen.2018.0281

Balderas, A., De-La-Fuente-Valentin, L., Ortega-Gomez, M., Dodero, J. M. & Burgos, D. (2018). Learning management systems activity records for students' assessment of generic skills. *IEEE Access, 6*, 15958-15968. https://doi.org/10.1109/ACCESS.2018.2816987

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M. & Rumble, M. (2012). Defining twenty-first century skills. In: Griffin, P., McGaw, B., Care, E. (Eds.) *Assessment and Teaching of 21st Century Skills.* (pp 17-66*).* Springer, Dordrecht. https://doi.org/10.1007/978-94-007-2324-5_2

Brandt, B., Lutfiyya, M. N., King, J. A. & Chioreso, C. (2014). A scoping review of interprofessional collaborative practice and education using the lens of the Triple Aim. *Journal of Interprofessional Care, 28*(5), 393-399. https://doi.org/10.3109/13561820.2014.906391

Brice, S. & Almond, H. (2020). Health Professional Digital Capabilities Frameworks: A Scoping Review. *Journal of Multidisciplinary Healthcare, 13*, 1375–1390. https://doi.org/10.2147/jmdh.s269412

Chan, C. K., Fong, E. T., Luk, L. Y. & Ho, R. (2017). A review of literature on challenges in the development and implementation of generic competencies in higher education curriculum. *International Journal of Educational Development, 57*, 1-10. https://doi.org/10.1016/j.ijedudev.2017.08.010

Data Protection Act 1050/2018. *Finlex.* (Translation in English) Available at: https://www.finlex.fi/en/laki/kaannokset/2018/en20181050.pdf

Declaration of Helsinki. (2013). Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191-2194. Available at: https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/

DeVellis, R. (2017). *Scale Development Theory and Applications* (4th ed.), Sage Publications, Thousand Oaks

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

Eskola, H., Kuivila, HM., Kääriäinen, M., Koskimäki, M., Koskinen, M. & Mikkonen, K. (2022). Social-, health care and rehabilitation educators' innovation and foresight competence (in Finnish). *Nursing Science, 34*(3), 183–194.

European Commission. (2015). *Directorate-General for Education, Youth, Sport and Culture, ECTS users' guide 2015*. Publications Office. Available at: https://data.europa.eu/doi/10.2766/87192

European Commission. (2016). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use.* Publications Office of the European Union. Available at: https://op.europa.eu/en/publication-detail/-/publication/3c5e7879-308f-11e7-9412-01aa75ed71a1/language-en

European Union. (2017). Recommendation on a European Qualifications Framework for lifelong learning and establishing a European Qualifications Framework for lifelong learning. Official Journal of the European Union. Council recommendation (2017/C 189/03). Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32017H0615(01).

European union (2018). Recommendations Council. Council recommendation of 22 May 2018 on key competences for lifelong learning 2018/c 189/01. The Council of the European union. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0604(01)

European Union. (2022). *State of Health in the EU Companion Report 2021*. Available at: https://eurohealthobservatory.who.int/publications/m/state-of-health-in-the-eu-companion-report-2021

Finnish National Board on Research Integrity TENK. (2019). *The ethical principles of research with human participants and ethical review in the human sciences in Finland*. https://tenk.fi/sites/default/files/2021-01/Ethical_review_in_human_sciences_2020.pdf

Flinkman, M., Leino, K. H., Numminen, O., Jeon, Y., Kuokkanen, L., Meretoja, R. (2017). Nurse Competence Scale: A systematic and psychometric review. *Journal of Advanced Nursing, 73*(5), 1035–1050. https://doi.org/10.1111/jan.13183

General Data Protection Regulation. (2018). *Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC*. Available at: http://data.europa.eu/eli/reg/2018/1725/oj

Haavisto, E., Siltanen, H., Tolvanen, A. & Holopainen, A. (2022). Instruments for assessing healthcare professionals' knowledge and skills of evidence-based practice: A scoping review. *Journal of Clinical Nursing, 00*, 1– 17. https://doi.org/10.1111/jocn.16506

Haddington, P., Hirvonen, N., Hosio, S., Kinnula, M., Malmberg, J., Seyfi, S., Simonen, J., Ahola, S., Cortés Orduna, M., Enwald, H., Haukipuro, L., Heikkinen, M., Hermes, J., Huikari, S., Iivari, N., Järvelä, S., Kanste, O., Kokkola, L., Kunnari, S., Kääriäinen, K., Mikkonen, K., Muukkonen-van der Meer, H., Nätti, S., Oittinen, T., Oloff, F., Räisänen, T., Saarinen, J., Sánchez, I., Siira, H., Stevenson, B., Suorsa, A., Svento, R., Toikkanen J., Ylioja, J. & Zabolotna, K. (2021). *GenZ White Paper: Strengthening Human Competences in the Emerging Digital Era [White Paper]*. University of Oulu. Available at: http://jultika.oulu.fi/Record/isbn978-952-62-3147-1

Heinen, M., van Oostveen, C., Peters, J., Vermeulen, H. & Huis, A. (2019). An integrative review of leadership competencies and attributes in advanced nursing practice. *Journal of Advanced Nursing, 75*(11), 2378–2392. https://doi.org/10.1111/jan.14092

Jokiniemi, K., Pietilä, A. & Mikkonen, S. (2021). Construct validity of clinical nurse specialist core competency scale: An exploratory factor analysis. *Journal of Clinical Nursing, 30*(13-14), 1863-1873. https://doi.org/10.1111/jocn.15587

Jordan, Z., Lockwood, C., Munn, Z. & Aromataris, E. (2019). The updated Joanna Briggs Institute Model of Evidence-Based Healthcare. *International Journal of Evidence- Based Healthcare, 17*(1), 58–71. https://doi.org/10.1097/XEB.0000000000000155

Kakemam, E., Liang, Z., Janati, A., Arab-Zozani, M., Mohaghegh, B. & Gholizadeh, M. (2020). Leadership and

management competencies for hospital managers: A systematic review and best-fit framework synthesis. *Journal of Healthcare Leadership, 12*, 59–68. https://doi.org/10.2147/JHL.S265825

Kantanen, K., Kaunonen, M., Helminen, M. & Suominen, T. (2015). The development and pilot of an instrument for measuring nurse managers' leadership and management competencies. *Journal of Research in Nursing, 20*(8), 667-677. https://doi.org/10.1177/1744987115605870

Kitson, A., Marshall, A., Bassett, K. & Zeitz, K. (2013). What are the core elements of patient-centred care? A narrative review and synthesis of the literature from health policy, medicine and nursing. *Journal of Advanced Nursing, 69*(1), 4–15. https://doi.org/10.1111/j.1365-2648.2012.06064.x

Knapp, T. R., & Brown, J. K. (1995). Ten measurement commandments that often should be broken. *Research in nursing & health, 18*(5), 465. https://doi.org/10.1002/nur.4770180511

Koskenvuori, J., Stolt, M., Suhonen, R. & Leino-Kilpi, H. (2019). Healthcare professionals' ethical competence: A scoping review. *Nursing Open, 6,* 5–17. https://doi.org/10.1002/nop2.173

Langins, M. & Borgermans, L. (2015). *Strengthening a competent health workforce for the provision of coordinated/integrated health services.* Working document. WHO, Geneva. Available at: https://www.euro.who.int/__data/assets/pdf_file/0010/288253/HWF-Competencies-Paper-160915-final.pdf

Legido-Quigley, H., Asgari, N., Teo, Y.Y., Leung, G.M., Oshitani, H., Fukuda, K., Cook, A.R., Hsu, L.Y., Shibuya, K. & Heymann, D. (2020) Are high-performing health systems resilient against the COVID-19 epidemic? *The Lancet, 395*(10227), 848–850. https://doi.org/10.1016/S0140-6736(20)30551-1

Maeda, A. & Socha-Dietrich, K. (2021). *Skills for the future health workforce: Preparing health professionals for people-centred care.* OECD Health Working Papers No. 124. Available at: https://dx.doi.org/10.1787/68fb5f08-en

Medical Research Act 1999/488. Available at: https://www.finlex.fi/fi/laki/kaannokset/1999/en19990488_20100794.pdf

Meretoja, R., Isoaho, H. & Leino-Kilpi, H. (2004). Nurse Competence Scale: Development and psychometric testing. *Journal of Advanced Nursing, 47*(2), 124–133. https://doi.org/10.1111/j.1365-2648.2004.03071.x

Mikkonen, K., Tomietto, M. & Watson, R. (2022). Instrument development and psychometric testing in nursing education research. *Nurse Education Today, 119*, 105603. https://doi.org/10.1016/j.nedt.2022.105603

Mikkonen, K., Tuomikoski, A., Sjögren, T., Koivula, M., Koskimäki, M., Lähteenmäki, M- L., Mäki-Hakola, H., Wallin, O., Sormunen, M., Saaranen, T., Koskinen, C., Koskinen, M., Salminen, L., Holopainen, A., & Kääriäinen, M. (2020). Development and testing of an instrument (HeSoEduCo) for health and social care educators' competence in professional education. *Nurse Education Today, 84*, 104239. https://doi.org/10.1016/j.nedt.2019.104239

Mokkink, L., Terwee, C., Knol, D., Stratford, P., Alonso, J., Patrick, D., Bouter, L. M. & de Vet, H. (2010). The COSMIN checklist for evaluating the methodological quality of studies on measurement properties: A clarification of its content. *BMC Medical Research Methodology, 10*(1), 22. https://doi.org/10.1186/1471-2288-10-22

Munro, B. H. (2005). *Statistical methods for health care research* (5th ed.). Lippincott Williams & Wilkins, Philadelphia.

National Research Council. (2013). *Education for life and work: Developing transferable knowledge and skills in the 21st century.* National Academies Press, Washington, DC. Available at: https://nap.nationalacademies.org/catalog/13398/education-for-life-and-work-developing-transferable-knowledge-and-skills

Nazeha, N., Pavagadhi, D., Kyaw, B. M., Car, J., Jimenez, G. & Car, L.T. (2020). A digitally competent health workforce: Scoping review of educational frameworks. *Journal of Medical Internet Research, 22*(11), e22706. https://doi.org/10.2196/22706

Organisation for Economic Co-operation and Development. (2018). *The future of education and skills: Education 2030*. Retrieved from: https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf.

Pett, M. A., Lackey, N. R. & Sullivan, J. J. (2003). *Making sense of factor analysis. The use of factor analysis for instrument development in health care research.* Sage Publications, Thousand Oaks.

Polit, D. F., Beck, C. T. & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing Health, 30*(4), 459-467. https://doi.org/10.1002/nur.20199

Polit, D. F., & Beck, C. T. (2021). *Resource manual for nursing research: Generating and assessing evidence for nursing practice* (11th edition.). Wolters Kluwer.

Pramila- Savukoski, S., Kärnä, R., Kuivila, H-M., Juntunen, J., Koskenranta, M., Oikarainen, A. & Mikkonen, K. (2022). The influence of digital learning on health sciences students' competence development– A qualitative study. *Nurse Education Today*. https://doi.org/10.1016/j.nedt.2022.105635

Skarbaliene, A., Skarbalius, E. & Gedrime, L. (2019). Effective communication in the healthcare settings: Are the graduates ready for it? *Management, 24*(SI), 137-147. https://doi.org/10.30924/mjcmi.24.si.9

Strudwick, G., Nagle, L., Kassam, I., Pahwa, M. & Sequeira, L. (2019). Informatics competencies for nurse leaders: A scoping review. *Journal of Nursing Adminstration, 49*(6), 323-330. https://doi.org/10.1097/NNA.0000000000000760

Tuononen, T., Hyytinen, H., Kleemola, K., Hailikari, T., Männikkö, I. & Toom, A. (2022). Systematic review of learning generic skills in higher education—Enhancing and impeding factors. *Frontiers in Education, 7*. https://doi.org/10.3389/feduc.2022.885917

van Laar, E., van Deursen, A. J., van Dijk, J. A. & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open, 10*(1), 1-14. https://doi.org/10.1177/2158244019900176

Von Elm, E. R., Altman, D. G, Egger, M., Pocock, S. L., Gotzsche, P. C. & Vandenbroucke, J. P. (2007). *Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies.* Strobe Initiative, Bern. Available at: https://www.equator-network.org/reporting-guidelines/strobe/

World Health Organization. (2010). *Framework for Action on Interprofessional Education and Collaborative Practice.* WHO, Geneva. Available at: https://apps.who.int/iris/bitstream/handle/10665/70185/WHO_HRH_HPN_10.3_eng.pdf;jsessio

World Health Organization. (2019). *WHO guidelines: recommendations on digital interventions for health system strengthening.* WHO, Geneva. Available at: https://www.who.int/publications/i/item/9789241550505

World Health Organization. (2022). *Working for Health 2022-2030 Action plan.* WHO, Geneva. Available at:

https://www.who.int/publications/m/item/w4h-action-plan-2022_2030.

Yong, A. G., & Pearce, S. (2013). A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. *Tutorials in quantitative methods for psychology*, *9*(2), 79-94. https://doi.org/10.20982/tqmp.09.2.p079

Author Information

Sari Pramila-Savukoski, MHSc
https://orcid.org/0000-0001-6590-1174
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu
Aapistie 5A, P.O. Box 5000
FI-90014, Finland
Contact e-mail: *sari.pramila-savukoski@oulu.fi*

Heli-Maria Kuivila, MHSc
https://orcid.org/0000-0001-8639-7640
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu
Aapistie 5A, P.O. Box 5000
FI-90014, Finland

Jonna Juntunen, MHSc
https://orcid.org/0000-0003-3195-8265
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu
Aapistie 5A, P.O. Box 5000
FI-90014, Finland

Miro Koskenranta, PhD
https://orcid.org/0000-0001-7842-2703
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu
Aapistie 5A, P.O. Box 5000
FI-90014, Finland

Erika Jarva, MHSc
https://orcid.org/0000-0001-6860-4319
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu Aapistie 5A, P.O. Box 5000
FI-90014, Finland

Anna-Maria Tuomikoski, PhD
https://orcid.org/0000-0001-9387-9058
The wellbeing services county of North Ostrobothnia
Oulu University Hospital, Oulu
Kajaanintie 50,
FI-90220 Oulu, Finland

Mira Hammarén, MHSc
https://orcid.org/0000-0002-2132-9812
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu
Aapistie 5A, P.O. Box 5000
FI-90014, Finland

Kristina Mikkonen, PhD, professor
https://orcid.org/0000-0002-4355-3428
Research Unit of Health Sciences and Technology
Faculty of Medicine, University of Oulu
Aapistie 5A, P.O. Box 5000, FI-90014, Finland
Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland.
Kajaanintie 50, FI-90220 Oulu, Finland