

Development and psychometric testing of the perception of nursing profession instrument

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Abstract

Background: Perceptions of the nursing profession influence career choices in nursing. An unrealistic perception might lead students to drop out of nursing education programmes. Objective measurement of the nursing applicants' perceptions at the student selection stage could enhance their career choices in nursing.

Aim: To develop and psychometrically evaluate the Perception of Nursing Profession Instrument (PNPI).

Design: Mixed method design.

Method: Two versions of the PNPI were developed during the years 2016–2022. The first version was based on documents describing the nursing profession and the second version was based on an integrative literature review, a focus groups study and a document analysis of descriptions of the nursing profession. The meta-ethnographic approach was used to synthesize the results and form a theoretical framework for developing the PNPI (60 items). Item content validity was evaluated by an expert panel of nurses ($n=7$). The psychometric properties of the instrument were analysed using the item response theory approach.

Results: The development process resulted in the 40-item PNPI with the following subscales: the content of nursing work, the career in nursing, the nature of nursing work and the characteristics of a nurse. The psychometric analysis revealed unidimensionality and goodness of fit to the partial credit model; however, the item difficulty was not well matched with the participants' abilities.

Conclusion: The PNPI is a novel instrument for objectively measuring perceptions of the nursing profession. For further development, item difficulty must be enhanced to improve the measurement accuracy of the nursing applicants' perceptions of the nursing profession.

Impact: Perceptions of the nursing profession influence career choices, but there is a lack of objective assessment instruments that can be used in nursing student selection setting to measure the perception. The results of this study offer an instrument to measure perception, while also suggesting ideas for further development.

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KEYWORDS

career choice, instrument development, item response theory, nursing, nursing education, perception, psychometric testing, student selection

1 | INTRODUCTION

A students' perception of the nursing profession is an essential factor in choosing their nursing career. Misperceptions of the profession might lead to a wrong career choice and can be a reason for attrition in education or for qualified nurses leaving the profession (Ten Hoeve et al., 2017). Misperceptions of the nursing profession make the field less appealing to possible nursing candidates (Miller & Cummings, 2009; Ten Hoeve et al., 2017; Zamanzadeh et al., 2013) when the goal is to create a more diverse nursing body (WHO, 2020a).

Nurses have a significant role in delivering quality care and they form the biggest group among healthcare workers globally. The nursing shortage is a global concern and according to World Health Organization's (WHO, 2020b) estimations, there is a need for additional 5.9 million nurses by 2030. As a solution to the nursing shortage, WHO urges governments to invest in nursing education and the attractiveness of the profession. In recent years, there has been an increase in baccalaureate programme enrolment (AACN, 2020), and the number of graduating nurses has been growing in Europe (Eurostat, 2020). Unfortunately, growth is not fast enough, and to meet demands, countries should increase the number of nurse graduates by at least 8% annually (WHO, 2020a). Moreover, high attrition rates in nursing education are an international concern. In Finland, the dropout rate is 9% (Kukkonen et al., 2016), the number varies from 3% to 60% in the UK, depending on the institution (Currie et al., 2014), up to 30% of students leave nursing education programmes in the United States, and in South Africa, dropout rates over 50% have been reported (Roos et al., 2016). The reasons for attrition vary; however, two of the common reasons identified are a wrong career choice (Kukkonen et al., 2016) and an unrealistic perception of the profession (Chan et al., 2019; Kukkonen et al., 2016).

Student selection is a process in which higher education institutions (HEI) select their students from a bigger pool of applicants. HEIs select students who meet their eligibility criteria and who are motivated, probably to complete their studies and suitable for the profession. The student selection procedures should be based on evidence and should be objective, transparent, non-discriminatory and cost-effective (Haavisto et al., 2019). Moreover, measuring the perception at the student selection stage could prevent wrong career choices in nursing (Chan et al., 2019). Assessment of the perception could be incorporated into nursing education entrance examinations to support retention in education and in the profession. Measuring the perception of potential nursing applicants is also necessary to influence perception and correct possible misperceptions. Currently, there is a lack of valid and objective instruments for measuring perception.

This study is part of a national Reforming Student Selection in Nursing Education (ReSSNE) project to develop and test an

evidence-based, objective and reliable method for nursing education in Finland. Nursing education in Finland is provided at universities of applied sciences (UASs), which are also responsible for student selection. The project was conducted in cooperation with nursing education researchers and six UASs. According to the findings of ReSSNE project, the realistic perception of the nursing profession is connected to the certainty of a career choice. In addition, to improve student selection in nursing education, ReSSNE project suggests measuring applicants' perceptions of the nursing profession alongside their learning skills and emotional intelligence at the application stage. In this article, we will introduce the development and psychometric testing of the Perception of Nursing Profession Instrument (PNPI). The PNPI belongs to the domain of career certainty (Haavisto et al., 2019). The instrument was developed for student selection purposes, and it intends to measure the nursing applicants' perception of the nursing profession objectively since attitudes or experiences cannot be evaluated and rated objectively as a part of student selection.

2 | BACKGROUND

Defining the nursing profession is challenging (Woodland et al., 2022), as it includes various unrecognized aspects (Jackson et al., 2021). The International Council of Nurses (ICN) defines nursing as autonomous and collaborative care of individuals of all ages, families, groups and communities in all settings. Nursing includes health promotion, prevention of illness and the care of ill, disabled and dying people. According to the ICN (2002), advocacy, promoting a safe environment, conducting research, shaping health policy and patients, running health management systems and providing education are also key nursing roles. In the history of nursing, nursing professionalism has been under discussion, and today, nursing is considered an evolving profession and an academic discipline. Nursing is an autonomous profession with ethical values and norms, and nursing professionals have a defined and specialized knowledge base, controlled education and a registration system. Nurses are committed to serving society and advancing the profession (McEwen & Wills, 2018). In Europe, member states of the European Union have developed standards for nursing and nursing education to harmonize the nursing profession in the European context (The European Parliament and the Council of the European Union, 2005, 2013). Moreover, nursing is defined in national descriptions of the nursing profession, such as official governmental guidelines or laws that set national standards for the profession. Currently, the definitions of nursing are targeted at professionals, and a more general description is needed to define the nursing profession for the public (Jackson et al., 2021; Woodland et al., 2022).

Perception is defined as an idea or mental image of something or the knowledge gained from the process of coming to know something (Merriam-Webster, 2022) and as the way something is understood or interpreted (Oxford Dictionary, 2022). Perception can also be understood as the result of developing an understanding through observation and as consciousness and awareness of something in light of experience (Merriam-Webster, 2022). Perception can also be seen as individuals' or groups' views of a phenomenon, which involves processing and interpreting the information based on their experiences (McDonald, 2012). According to Bandura's (1971) social learning theory and Bem's (1972) self-perceptions theory, perceptions are the result of social interaction with the surrounding environment. In the nursing context, family, friends, media and personal experiences have been stated as influences on perceptions of the nursing profession (Glerean et al., 2017, 2019). The unrealistic portrayal of nurses in the media affects the public image of nursing, as the independence of the profession and the versatile, complex tasks and roles of modern nurses are not fully recognized in society (Price & McGillis Hall, 2014; Ten Hove et al., 2017; Teresa-Morales et al., 2022). In this study, perception is defined as a mental image of the nursing profession that is based on knowledge and is a result of social interactions with the surrounding environment.

Perception of the nursing profession influences career choices in nursing (Glerean et al., 2017, 2019), nursing students' retention in nursing education programmes (Chan et al., 2019) and professional nurse turnover (Başkale & Serçekuş, 2015). Young people's perceptions about the nursing profession have primarily been studied from a career choice perspective, and some studies describe the change in perceptions during nursing education. According to Mooney et al. (2008), career choices in nursing are often influenced by altruistic motivations and reasons to enter education may be intrinsic, such as desire to become a nurse, or extrinsic, such as job security and versatile opportunities for work (Mooney et al., 2008; Ten Hove et al., 2017). Based on the findings of previous studies, nursing applicants have unrealistic perceptions (Glerean et al., 2017, 2019); however, they seem to shift towards more accurate ones during education (Safadi et al., 2011).

Currently, to our knowledge, instruments to objectively measure nursing applicants' perceptions as part of student selection for nursing education do not exist. In the literature, there are some instruments that are used to describe the perceptions related to the nursing profession; however, they measure different concepts, such as nurses' self-image (Porter & Porter, 1991), healthcare professionals' nursing image (Sand-Jecklin & Schaffer, 2006), attitudes (May et al., 1991; Toth et al., 1998) or orientation (Vanhanen & Janhonen, 2000) to the nursing profession, and they are self-evaluation instruments. Porter and Porter's (1991) Nursing Image Scale (NIS) measures nurses' perceptions of their profession. The instrument consists of 30 adjectives that form three subgroups: interpersonal power (13 items), interpersonal relations (10 items) and intrapersonal ability (7 items). NIS uses a 7-point Likert scale and the reliability in a few studies is reported to be good (Natan, 2016). Another instrument investigating the nurse image among health professionals is the

Perceptions of Professional Nursing Tool created by Sand-Jecklin and Schaffer (2006), with 37 items investigating nursing practice, values and public image. Responses were measured using a 5-point Likert scale, and its reliability has been assessed as moderate in recent studies (Fillman, 2015). Moreover, Vanhanen and Janhonen's (2000) Nursing Orientation Tool is used (e.g., Grainger & Bolan, 2006; Ten Hove et al., 2017) to measure orientation to nursing in the realms of caring, nursing experience and life orientation. The instrument consists of 15 items and the response format is a 5-point Likert scale. The validity and reliability of the tool have been reported as satisfactory (Rubbi et al., 2019; Vanhanen & Janhonen, 2000). Moreover, the Nursing Attitude Questionnaire (NAQ) created by Toth et al. (1998) has been used in previous studies (e.g. Rubbi et al., 2017; Ten Hove et al., 2017) that describe attitudes towards the nursing profession. The NAQ measures nursing roles, values and responsibilities, characteristics of a nurse, nursing professionalism and stereotypes in society with 30 items. The response format is a 5-point Likert scale, and validity and reliability have been reported as good (e.g. Rubbi et al., 2017). The Indiana Instrument created by May et al. (1991) measures attitudes towards the nursing profession. The instrument consists of two parallel instruments that measure nursing as a career and ideal career with 17 identical items using a 5-point Likert scale. The Indiana Instrument's content validity was originally assessed by expert panels, and the instrument has been assessed for reliability in later studies (e.g. Degazon et al., 2015).

There are some limitations to using the existing instruments to measure the perceptions of nursing applicants to nursing education as a part of the student selection. First, to our knowledge, there are no validated instruments to measure nursing applicants' perceptions of the nursing profession. Second, the existing instruments are self-evaluation instruments, which are not applicable to student selection (Rankin, 2013). Third, the literature lacks a comprehensive definition of the nursing profession. Therefore, there is also a need to clarify the theoretical framework and to operationalize the concept of 'perception of nursing profession' to be able to measure it accurately as a part of student selection for nursing programmes.

3 | THE STUDY

3.1 | Aim

The aim of this study was to develop and psychometrically test the PNPI. The purpose of the instrument is to measure nursing applicants' perceptions of the nursing profession.

3.2 | Methodology

This study used a mixed methods design (Polit & Beck, 2018) and was conducted in two phases: (1) development of the PNPI (version 1, version 2) and (2) psychometric evaluation of the PNPI (version 2; Figure 1).

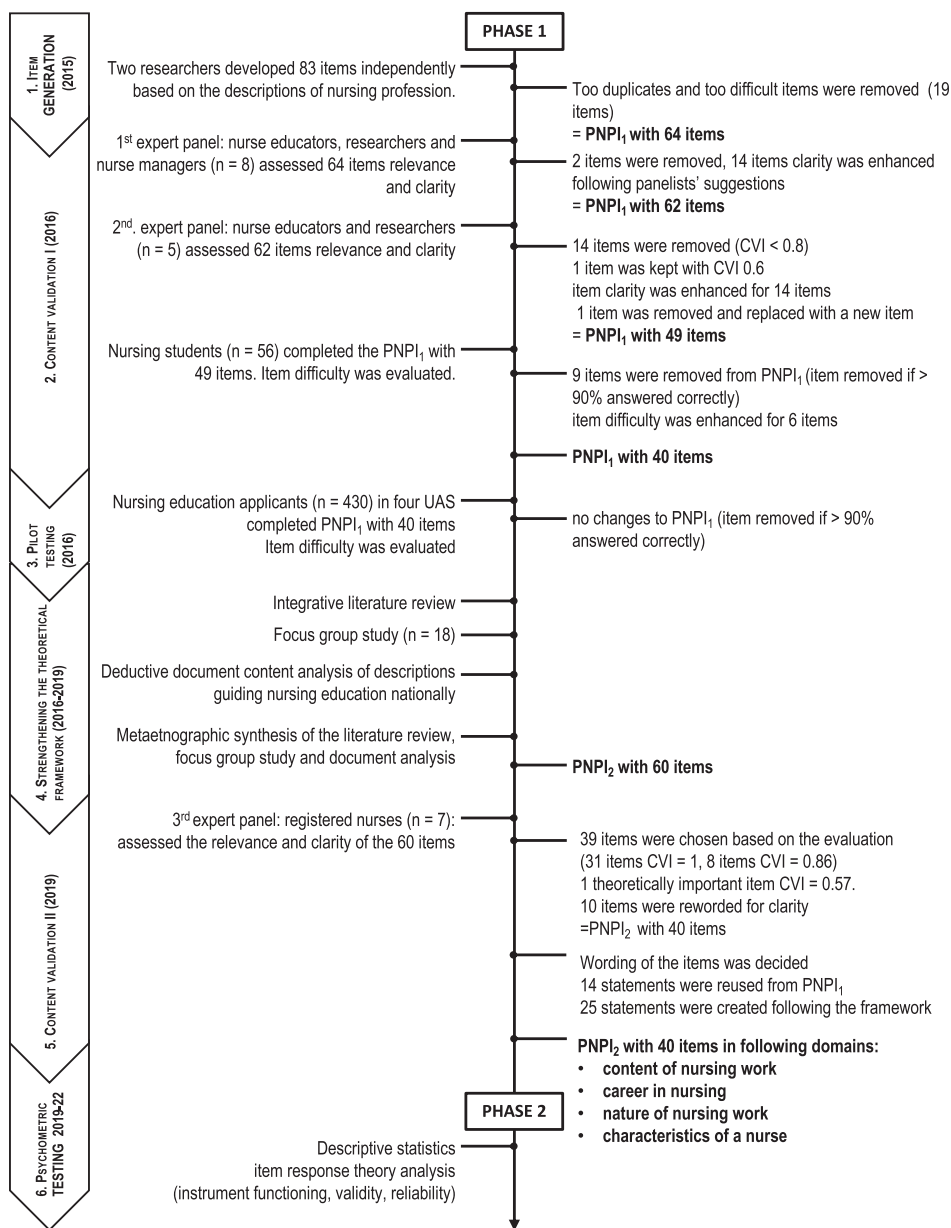
In the development phase, the aim was to create a theoretical framework for the instrument and to generate items for the instrument. The first version (PNPI₁) was developed in the following stages: item generation, content validation I and pilot testing. It was carried out in 2015–2016. As PNPI₁ needed improvement, the second version (PNPI₂) was developed in 2016–2019. The development of PNPI₂ included strengthening the theoretical framework and content validation II.

In the psychometric evaluation phase (2019–2022), the aim was to test the psychometric properties of the PNPI₂. The psychometric evaluation phase included item functioning, validity and reliability evaluation of the PNPI using the item response theory approach (DeVellis, 2017), and it was carried out in 2021–2022. The development process of the PNPI is shown in Figure 1.

3.3 | Phase 1: Development of the PNPI

3.3.1 | Item generation (PNPI₁)

The aim of the item generation stage was to develop the items for the PNPI₁ (Figure 1). Item generation was conducted in 2015. Two researchers conducted the item generation independently based on descriptions of the nursing profession which are all freely available for nursing applicants (*nurses' competence requirements in Finland, Finnish Nurses Association's description of the nursing profession, national career planning website with job descriptions*). Items were created in the following topics: nursing care, ethics in nursing, professionalism in nursing, leadership, interaction, collaboration and networking,



Development of PNPI₁: stages 1-3, Development of PNPI₂: stages 4-6

FIGURE 1 The development process of the Perception of Nursing Profession Instrument (PNPI).

work environment and nursing education. In the end, 83 items were generated. The items were statements of the nursing profession, such as 'independent decision making is a part of nurses' work'.

The inclusion and exclusion criteria of the PNPI₁ items were discussed by three researchers. Based on this discussion, 19 items were removed because they were duplicates or considered too difficult. Item generation resulted in PNPI₁ with 64 items.

3.3.2 | Content validation I (PNPI₁)

The aim of the content validation stage was to evaluate the PNPI₁'s content validity (Figure 1). Content validity was evaluated to confirm that the instrument provided an adequate representation of the construct it was created to measure (DeVon et al., 2007). Content validation was carried out in 2016.

The content validity of the 64 items was evaluated by two expert panels (Figure 1). First, the items were evaluated by the ReSSNE project group ($n=8$), which consisted of nurse educators, researchers and nurse managers who were experienced with student selection in nursing education. All members evaluated the items for relevance and clarity individually using a 4-point Likert scale (1 = not relevant, 4 = very relevant). The content validity index (CVI) was calculated for each item and was followed by face-to-face discussions about item relevance and clarity (Polit & Beck, 2006). Based on the evaluations, two items were removed (CVI = 0.8), and modifications were made to enhance the clarity of the items ($n=14$). All in all, 62 items were included in the PNPI₁.

Second, the 62 modified items were evaluated by an expert panel ($n=5$) of nurse educators and researchers who were experienced with student selection in nursing education (Figure 1). Purposive sampling was used in the recruitment of the panellists. Experts evaluated items for relevance and clarity using a 4-point Likert scale (1 = not relevant, 4 = very relevant). The CVI for the item relevance was calculated and items with low CVI (CVI < 80) were removed ($n=14$; Polit & Beck, 2006). One item with low CVI (0.6) was kept in the instrument because it was considered theoretically important. After this, item clarity ($n=14$) was enhanced according to the expert panel evaluations (CVI < 80). One unclear item was removed and replaced with a clearer one. In the end, content evaluation resulted in the PNPI₁ with 49 items.

Last, the item difficulty of the 49 items was evaluated by voluntary first-year nursing students ($n=56$) who were at the beginning of their studies (Figure 1). Purposive sampling was used in the recruitment of the participants. Participants were informed about the study and its voluntary nature, and they gave their consent to participate. In the item difficulty analysis, the participants answered to the instrument and the proportion of correct answers for each item was calculated as a percentage. Following the evaluations, nine items were removed (100% answered correctly) and six items were modified (more than 90% answered correctly) to achieve a higher item difficulty level. The final version of PNPI₁ included 40 items, measuring perceptions of the nursing profession based on the following domains: nursing care

(15 items), ethics in nursing (5 items), professionalism in nursing (5 items), leadership (3 items), interaction, collaboration and networking (4 items), work environment (4 items) and nursing education (4 items). The items were statements relating to the nursing profession, such as 'Ethical principles guide nurses' work'.

3.3.3 | Pilot testing (PNPI₁)

The aim of the pilot testing stage was to test the discriminatory power of the instrument. The PNPI₁ was pilot tested in 2016 in four UASs in Finland with voluntary applicants to nursing education programmes ($n=430$) who provided their approval for the use of their data in this study, participated in the entrance examination in one of the four UASs who were involved in the ReSSNE project. They were informed and invited to participate in the study via an entrance examination invitation letter.

The data ($n=430$) were analysed using descriptive statistics, and the aim of this pilot test was to enhance the discriminatory power of the items. Therefore, the items were checked for the proportion of correct and incorrect answers. An item was deleted if more than 90% or less than 10% of the participants answered it correctly. In the end, no items were removed.

3.3.4 | Strengthening the theoretical framework of PNPI (PNPI₂)

In this stage, we developed a second version of the instrument to strengthen the theoretical framework of PNPI₁. To provide a more in-depth, international and structured description of the perception of the nursing profession, an integrative literature review, focus group study, deductive document analysis and meta-ethnographic approach to synthesize all the qualitative datasets were conducted in 2016–2019 to develop the second version of the instrument.

First, an integrative literature review was carried out following the process of Whitemore and Knafl (2005) using three databases to gather existing literature and to produce descriptive information about the studied phenomenon. The aim of the literature review was to describe the perceptions of the nursing profession among young people and to identify the factors influencing their perceptions. The literature search resulted in eight articles and the quality of the chosen articles was assessed with Joanna Briggs Institute's quality appraisal tools. Inductive analysis was used as an analysis method. The perception of the nursing profession was described in terms of (1) the nature of nursing work, (2) the contents of nursing work, (3) the requirements of nursing work, (4) nursing as a career choice and (5) the characteristics of a nurse (Glerean et al., 2017).

Focus group interviews aimed to understand the perception of the nursing profession at the student selection stage and to confirm the theoretical framework of the PNPI (Doody et al., 2013). Three structured focus group interviews were conducted in the fall of 2016 in three UASs. Purposeful sampling was used. Participants

($n=18$) were voluntary nursing applicants who were invited to the entrance exam of one of the UAS which participated in the ReSSNE project. They were informed and invited to participate in the study via an entrance exam invitation letter. Inductive content analysis was used to analyse the data (Elo & Kyngäs, 2008). The focus group study confirmed the previous findings and the perception of the nursing profession was described in terms of (1) the nature of nursing work, (2) the content of nursing work, (3) nursing as a career choice and (4) characteristics of a nurse (Glerean et al., 2019).

After the focus group study, there was a need to describe how the profession is presented in documents that guide nursing education nationally and to gain a broader understanding of the descriptions of the nursing profession in Finland. Relevant freely available documents such as nurses' national competence requirements, the Finnish Nurses Association's and International Nurses Council's descriptions of the nursing profession and national reports and legislation describing the nursing profession in Finland were analysed. The content analysis of the documents was conducted deductively (Elo & Kyngäs, 2008), and the analysis matrix was based on the results of the previous focus group study (Glerean et al., 2019). As a result, two new subcategories were formed: *ethical principles in the nursing profession* under the main category of nature of nursing work and *professional identity* under the main category of characteristics of a nurse.

Last, a meta-ethnographic approach was used to synthesize all collected qualitative data sets (literature review, focus group study and deductive document analysis) to form a theoretical framework for the PNPI₂. In the analysis process, the results from the qualitative studies (integrative review, focus group study and document analysis) were inserted in a table so that all the main categories, subcategories and factors were visible (Table 1). The research group looked for similarities in different subcategories and factors, relocated similar factors together and renamed the new groups when necessary (Campbell et al., 2011). The following four main categories emerged: (1) the content of the nursing work, (2) the career in nursing, (3) the nature of the nursing work and (4) the characteristics of a nurse. These four categories formed the subscales for the PNPI₂ and 60 items were developed following the factors of the newly developed theoretical framework. The items were such as decision-making in nursing profession and documentation in the nursing profession.

3.3.5 | Content validation II (PNPI₂)

The aim of the content validation II was to evaluate items' ($n=60$) content validity (Rattray & Jones, 2007) using expert panels. Participants of the third expert panel were invited to the study via the Finnish Nurse Association, and seven voluntary registered nurses (2 from long-term care, 2 from specialized care, 2 from primary healthcare and 1 from digital nursing) participated in the expert evaluation (Polit & Beck, 2006). Expert panellists were informed about the study via email, and they contacted the researcher if they were available. Content validation II was conducted in the spring of 2019. The expert panel evaluated items for relevance and

clarity in two rounds. In the items' relevance assessment, experts were asked to evaluate how relevant the item is for a nursing applicant to know at the application stage. The relevance was assessed using a 4-point Likert scale (1=not relevant, 4=very relevant) and clarity was assessed using a dichotomous scale (yes/no). If the item was unclear, the expert panel member was asked to provide a rationale and a suggestion for improving the item. The CVI for item relevance ranged from 0.57 to 1.00. Unclear items (10 items) were modified for clarity based on expert suggestions. The expert panel re-reviewed the 60 items for clarity after the modifications and no changes were suggested. The final content of PNPI₂ was decided by the research group ($n=4$). Of 60 items, 39 were included in PNPI₂ (31 items CVI = 1, 8 items CVI = 0.86). Moreover, one item with a CVI of 0.57 was included because it was considered theoretically important (Polit & Beck, 2006). The total number of items in PNPI₂ was 40.

Finally, the exact wording of the 40 items was determined. The items had to be further developed as statements of the nursing profession. We included 14 items (statements of the nursing profession) from PNPI₁ because they matched PNPI₂'s theoretical framework, and their discriminatory power was considered good, according to the earlier pilot test stage. In addition, the research group developed new positively and negatively worded statements (26 items) following the framework.

3.3.6 | Instrument

The PNPI₂ measures the perception of the nursing profession based on four domains: (1) content of the nursing work (12 items), (2) career in nursing (10 items), (3) nature of the nursing work (12 items) and (4) characteristics of a nurse (6 items; Table 2). In total, the instrument consists of 40 items. The items are comprised of statements related to the nursing profession, such as 'Nurses work as a part of multi-professional teams' and 'Nurses have career development possibilities'. The response options for the instrument are correct/uncertain/incorrect. The instrument was developed in digital form and stored in the digital entrance examination system. Students answered by ticking the appropriate box. Scores for the respondents are calculated in the following way: Every correct answer will give 0.5 points, an uncertain answer will give 0 points, and incorrect and unanswered items will give -0.5 points. Thus, higher scores indicate a more correct perception of the nursing profession.

3.4 | Phase 2: Psychometric testing of the PNPI (PNPI₂)

In the second phase of the study, the aim was to test the psychometric properties of the PNPI₂. Psychometric testing is a fundamental step during instrument development that aims to assess the validity and reliability of the instrument (DeVon et al., 2007). The PNPI was developed for entrance exam purposes, and the participants' performance is measured by the amount of correctly answered items. Therefore,

TABLE 1 An example of meta-ethnographic synthesis of the indirect nursing tasks subcategory (part of the main category content of nursing work). All the main and subcategories are described in Table 2.

Data 1: Review	Data 2: Focus group	Data 3: Document analysis	Synthesis
Subcategory	Subcategory	Subcategory	Subcategory
Working with technology ¹	Indirect nursing tasks	Indirect nursing tasks	Indirect nursing tasks
	Preparatory nursing tasks	Preparatory nursing tasks	Preparatory work
	Factors (=narratives to explain each category)	Using digital services	Documentation and the use of digital information systems
	Factors (=narratives to explain each category)	Documentation	Quality management
	Factors (=narratives to explain each category)	Quality management	Guidance of co-workers
	Factors (=narratives to explain each category)	Guidance of co-workers	Research and development work
	Factors (=narratives to explain each category)	Research and development work	Coordinating the patient care
	Factors (=narratives to explain each category)	Preparation of educational material	
	Factors (=narratives to explain each category)	Coordinating the patient care	
	Factors (=narratives to explain each category)	Societal impact	
	Factors (=narratives to explain each category)	Patient Advocacy ²	

¹ moved to subcategory work career.

² moved to subcategory direct nursing tasks.

the item functionality, item difficulty and the PNPI₂'s ability to separate high- and low-performing individuals were also evaluated.

In the psychometric testing, item response theory (IRT) was used. With IRT, it is possible to test how well the items of an instrument conform to a unidimensional model of the latent trait, a single underlying construct, which in this case is the ability of the individuals to succeed on the entrance exam. The IRT approach offers the opportunity to test the properties of the items in relationship to the latent variable and, eventually, to identify poorly functioning items to further enhance the instrument. IRT is not sample dependent, and it can also be used to assess the performance of the individuals to exclude those who show a misfit pattern of answers (e.g. due to guessing) as well as separate high and low performers (Boone, 2016). The process of psychometric evaluation for the PNPI₂ is summarized in Table 4 (Stolt et al., 2021, 2022).

3.4.1 | Participants and data collection

The psychometric properties of the PNPI₂ were tested as part of the digital national entrance exam of nursing education in six UASs that took part in the ReSSNE project on 28 May 2019. The participants in the study ($n=1121$) were applicants to nursing education programmes who completed the ReSSNE entrance exam and who gave permission to use their data in this study. Prior to completing the exam, participants were informed about the study and their rights as participants, and they gave their consent electronically. The digital version of the instrument was used for data collection, and the minimum required sample size to evaluate the construct validity was determined (DeVon et al., 2007). After excluding 6 participants who did not answer more than 80% of the questions (32 or more questions), the final number of participants was 1115 (the total population applying to nursing education programmes in Finland is approx. 18,000). Participants' characteristics are provided in Table 3.

3.4.2 | Data analysis

In this study, the partial credit model was used to assess the psychometric properties of the instrument. The partial credit model is an extended Rasch model used for polytomous scales, which in this study consists of three response categories: (i) incorrect (-1), (ii) uncertain (0) and (iii) correct (+1). Data were pre-processed using custom Python scripts to validate the answers of the participants, and missing values were replaced with the median. The statistical analysis was performed with the freely available eRm (Mair & Hatzinger, 2007) and iarm (Müller, 2020) R packages. Table 4 shows a summary of the steps taken to test the psychometric properties of the instrument. The R code used in this paper is openly shared at <https://github.com/eglerean/sulo>.

First, the functioning of the instrument can be tested by considering the distribution of item difficulties across the latent trait dimension and by verifying that the thresholds for each item should

TABLE 2 The structure of the Perception of the Nursing Profession Instrument (PNPI₂).

Subscales in PNPI ₂	Content	Number of items in PNPI ₂
Content of the nursing work	Indirect nursing tasks	n = 12
	Direct nursing tasks	
	Decision-making	
Career in nursing	Education	n = 10
	Work career	
Nature of the nursing work	Evidence-based practice	n = 12
	Multiprofessional teamwork	
	Demands of the work	
	Ethical principles in the nursing profession	
	Knowledge and skill requirements	
Characteristics of a nurse	Autonomy of the profession	n = 6
	Attitude	
	Personal characteristics of a nurse	
	Professional identity	
		Total=40

TABLE 3 Demographic information of participants.

(n = 1115 ^a)				
Variable	N	%	Range	Mean (SD)
Age in years	1108		18–55	24.41 (7.12)
Sex				
Female	954	86		
Male	155	14		
Background education				
High school	596	53.7		
Vocational school	514	46.3		
Previous degree in higher education				
Yes	97	8.8		
No	1007	91.2		
Previous applications for nursing education				
Yes	452	40.8		
No	655	59.2		

^aMissing values: age in years (N=7), gender (N=6), background education (N=5), previous degree in higher education (N=11), previous applications for nursing education (N=8).

follow the response categories order (Table 4, step 1). It is recommended that the items fully cover the latent construct, with item difficulties possibly distributed between 3 and -3 logits, without leaving large gaps in the range. This can be visualized in a Wright

map, together with the distribution of the total score for each participant. This visualization summarizes the distribution of items and persons on a common logit scale, and it allows direct visual comparison by considering how close the mean item measure is to the mean person measure to ensure that the range of presented items is suitable for the group of respondents (Boone, 2016).

Instrument validity and reliability can be evaluated with IRT by considering (1) how well the items are performing given what is predicted by the model (Table 4, step 2), (2) how well the items represent a unidimensional latent variable (Table 4, step 3), (3) how independent the items are from one another (Table 4, step 4) and (4) how reliable is the hierarchy of item difficulties (Table 4, step 5; Bond et al., 2020). In this study, the model's residuals were examined to estimate the validity of the items by calculating two goodness-of-fit statistics: infit and outfit (Table 4, step 2). The statistical significance of the conditional goodness-of-fit statistics can be evaluated with *p* values. In this study, *p* values were corrected for multiple comparisons using Bonferroni correction across the 40 items; hence, the statistical threshold was set to 0.05/40=0.00125. The unidimensionality of the instrument was verified with the Martin-Löf test as implemented in eRm (Table 4, step 3). The Martin-Löf test produces a significant *p* value if the unidimensionality criterion is not met. Then, to further assess the validity of the instrument, the test of local dependence for the items was run to control for the independence of the items (Table 4, step 4). Items displaying absolute values larger than 0.2 are significantly dependent (Christensen et al., 2017) which indicates the redundancy of the items. Finally, item separation reliability was also examined (Table 4, step 5) and is expected to be larger than 0.9 (Linacre, 2011).

Another advantage of IRT is the opportunity to evaluate the validity and reliability of the participants' response characteristics with persons' infit and outfit statistics (Table 4, step 6). Infit and outfit threshold *z*-values of ± 2 were chosen to identify which participants displayed inconsistent behaviour in their answers. Less than 5% of participants should show poor goodness of fit (Kottorp et al., 2003). Here, the percentage of misfit participants was reported; however, these participants were not excluded from the analysis. Moreover, person separation reliability (PSR) was examined (Table 4, step 7). PSR is expected to be larger than 0.8 for the tool to be able to reliably separate between two groups of low and high performers (Milliken et al., 2018).

3.4.3 | Ethical considerations

Ethical principles on the responsible conduct of research set by the National Advisory Board (TENK, 2012) on research ethics were followed throughout the study. Approval to conduct the study was obtained from the ethics committee 30th of September 2016 and 14th of April 2019. Institutional permissions to conduct the study were obtained from the directors of all participating UASs. All study participants were informed about the purpose of the study, its voluntary anonymity nature and their rights as study participants. Participants gave their consent to be included in the study. Consent was asked separately in a written form from all participants, except

TABLE 4 Process for the PNPIs psychometric evaluation.

Steps	Psychometric property	Statistical approach and criteria used in this study	Results
1	Instrument functioning and item thresholds Does the instrument function consistently across items?	PCM model to assess the item difficulty. Items thresholds are expected to uniformly cover a wide range of difficulties for the latent trait. Thresholds for each item should follow response categories order. (Bond et al., 2020)	Most items were very easy. The order of thresholds was inverted for most of the items.
2	Internal validity Does each item match the response expected according to the Rasch model?	Item conditional infit and outfit statistics with Bonferroni corrected p value $<.05$. (Bond et al., 2020)	Three items ($n=3$) were not fit to the model.
3	Internal validity Is the instrument unidimensional?	Martin-Löf's Likelihood-Ratio Test with p value $>.05$. (Christensen et al., 2017)	The unidimensionality was satisfactory.
4	Internal validity Are the items independent?	Test of local dependence for the items. Dependent items with residual covariance >0.2 or <-0.2 . (Christensen et al., 2017)	Seven items ($n=7$) showed significant dependence, especially items belonging to subcategory 4.
5	Instrument reliability Is the person sample large enough to confirm the item difficulty hierarchy (=construct validity) of the instrument?	Item separation reliability is expected to be larger than 0.9. (Linacre, 2011)	ISR was 0.945.
6	Person response validity How closely do the individual responses match the responses expected according to the Rasch model?	Persons' infit and outfit statistics with Z values between -2 and 2 . Less than 5% of participants with goodness-of-fit outside the desired range. (Kottorp et al., 2003)	Only 4.70% of participants did not show acceptable goodness of fit.
7	Person-separation reliability Can the tool separate two distinct groups of participants?	Persons-separation reliability is expected to be larger than at least 0.7, ideally larger than 0.8. (Milliken et al., 2018)	PSR was 0.605.

in the first item-difficulty evaluation. Nursing school applicants did not give written consent and responding to the PNPI was considered consent for participation. This procedure was accepted by the ethics committee in 2016 and it followed ethical recommendations (TENK, 2012). As applicants to nursing education are in a vulnerable position, it was made clear that participating in this study would not affect the evaluation of the entrance exam.

4 | RESULTS

4.1 | Demographic information of participants

In total, 1115 nursing applicants consented to participate in the study. The majority of the participants were females (86%) and the mean age of the participants was 24 years (range 18–55, SD 7.12). Most of the participants did not have a previous degree in higher education.

4.2 | Psychometric properties of the PNPI2

The main results for each analysis step performed are summarized in Table 4. In summary, the items were rather easy for this group of

participants and the instrument did not separate high performers particularly well from low performers.

4.2.1 | Instrument functioning and item thresholds

Instrument functioning (Table 4, step 1) is summarized in the Wright map in Figure 2, with item locations and person distribution. Items were easy for this group of participants, and this is visualized in the Wright Map which highlights a mismatch between the difficulty of the items and the ability of the participants: While the item difficulties are centred around the zero on the logit scale, the sample is highly able with person distribution centred around $+2$ logit, with almost half of the items (19 items) correctly answered by more than 90% of the participants. Furthermore, the instrument does not cover the full continuum of the construct (recommended range -3 to 3) with only one item with a location higher than 1 logit (see also Figure S2). Moreover, many items are located at the same level, close to the 0 logit, which might demonstrate redundancy between the items. Item location and thresholds for the partial credit model are reported in Table S2, along with the percentages of the answers. Figure S2 shows the Wright map with all item thresholds. The order of the thresholds was reversed for most of the items.

4.2.2 | PNPI₂ validity and reliability

Item goodness-of-fit statistics are reported in [Table S3](#). When considering the infit statistics ([Table 4](#), step 2), three items (C2–Q4, C2–Q23 and C3–Q37, marked with a star in [Table S3](#)) did not fit with the model, indicating a potential need for revision of the items (Bond et al., 2020). Next, the unidimensionality of the measured latent variable was successfully confirmed by the Martin-Loef test (split criterion: median, LR value: 863.653, Chi-square df: 1599, *p* value: 1) indicating that the instrument measures one latent construct (Boone, 2016; [Table 4](#), step 3). The test for local dependence identified seven items with a significant residual correlation indicating a redundancy between the items ([Table 4](#), step 4; see also [Table S3](#)). Most of the items in subscale four show a strong local dependence, indicating that these items are redundant and possibly measuring the same thing (Bond et al., 2020). Item 23 was anti-correlated with item 2, indicating a misfit for this item. Item separation reliability was 0.945, indicating that the sample used was large enough to assess the properties of the instrument ([Table 4](#), step 5).

4.2.3 | Persons fit statistics and person separation reliability

The participants showed an acceptable goodness of fit with the model. The percentage of misfit individuals whose infit and outfit *z*-statistics were larger than 2 or smaller than –2 was 4.70%, which is in accordance with the recommendations (Kottorp et al., 2003; [Table 4](#), step 6).

Person separation reliability was 0.605. ([Table 4](#), step 7). An instrument is expected to have a value of person separation reliability of at least 0.8. This indicates that the instrument is not able to properly separate the high-performing participants from the low-performing participants, probably due to the mismatch of the items' difficulties and individuals' abilities.

5 | DISCUSSION

This study aimed to develop and psychometrically test an objective instrument to measure the perception of the nursing profession to be used in student selection in nursing education in Finland. According to earlier studies, young people's perceptions of the nursing profession are unrealistic, and measuring the perception at the student selection stage could foster career choices in nursing (Glerean et al., 2017, 2019). However, we lack theoretically sound and valid instruments to objectively measure the perception of the nursing profession as a part of the nursing education entrance exam.

In the first phase of the study, a theoretical framework was developed to operationalize the concept of perception of the nursing profession. Based on this study, perception of the nursing profession is defined as a mental image based on knowledge

of the nursing profession, which includes content of the nursing profession, nature of the nursing profession, career in nursing and characteristics of a nurse ([Table 2](#)). The mental image of the nursing profession evolves through interactions with the surrounding environment. The theoretical framework of the perception of the nursing profession was investigated using various qualitative methods to ensure a valid operationalization of the concept. The perception of the nursing profession was examined from different perspectives (earlier literature, nursing applicants and public descriptions of the profession) using different research methods. The content validity of the PNPI was assessed by several multi-professional expert panels, and good content validity was indicated (Polit & Beck, 2006). Compared with earlier definitions of the nursing profession, this study offers a comprehensive theoretical framework for the perception of the nursing profession. Earlier definitions focused on defining nursing from a professional perspective, which might be too theoretical and complex to understand for the nursing applicants and for the public. The newly developed framework also underlines nursing professionalism, which is an important factor when updating the image of the nursing profession. While the theoretical framework was developed for the PNPI, it can be used to plan interventions to update the image of the nursing profession so that it underlines autonomy and the academic requirements of the profession, which have not been fully recognized among possible nursing applicants (Price & McGillis Hall, 2014; Ten Hoeve et al., 2017; Teresa-Morales et al., 2022).

In the second phase of the study, the psychometric properties of the PNPI₂ were evaluated. The analyses of the psychometric properties supported the satisfactory validity of the PNPI. However, to improve PNPI's validity and ability to separate between low- and high-performing applicants, the PNPI will need to be further developed. First, the difficulty level of the items needs to be enhanced to improve the measurement accuracy and efficiency. Also, there was a mismatch between the item difficulty and the ability of the participants. Items were too easy with item thresholds located mostly under 0 logit; therefore, the performance of the participants was skewed towards very high scores ([Figure 2](#): Wright map). For this reason, it is difficult to truly distinguish between low and high performers. This result is also supported by a low person separation reliability score (PSR=0.6, recommended level > 0.8). Second, the misfitting items should be investigated and possibly modified or removed. Q23—the only item with the highest level of difficulty—was not satisfactory according to the goodness-of-fit criteria, which can demonstrate difficulty in the comprehension of the item rather than measuring higher ability of participants (i.e. high performers in other items have answered Q23 incorrectly, while some low performers have answered correctly). The other two items (Q4 and Q37) showed misfits, which might indicate that the structure, content or wording of the items needs to be revised. Moreover, the removal of the misfitting items might improve the model fit. In addition, the removal of the items should be done item by item, not simultaneously, because the

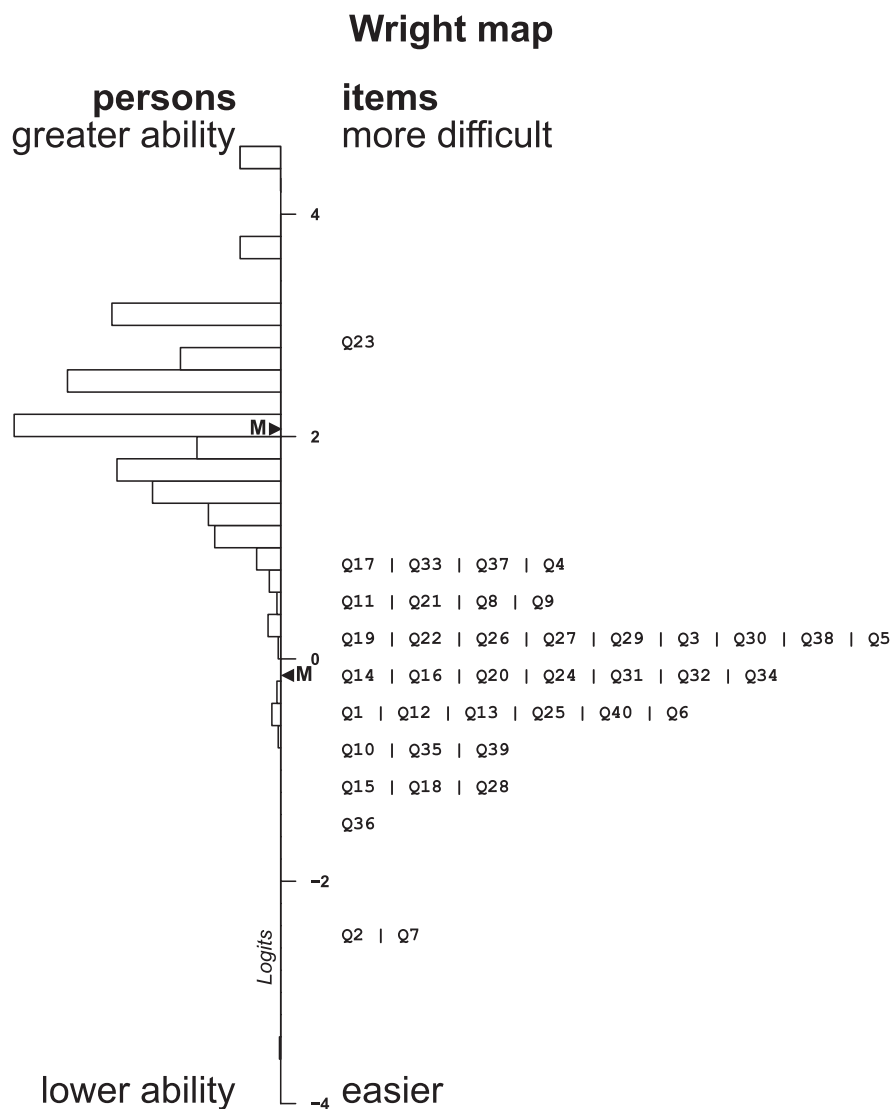


FIGURE 2 Wright Map Each item (on the right-hand side) is shown at the measured location (equivalent to item difficulty). Participants' performance (on the left-hand side) is skewed towards the top as most participants correctly answered most of the questions. This results in a large gap between the means of the two distributions. See also [Figure S2](#) in the supporting information.

removal of one misfitted item might improve the fit of other misfitting items (Hagquist et al., 2009). Misfitting items might be due to respondents answering patterns and behaviour such as guessing, and this could be further examined in future analysis (Tennant & Conaghan, 2007). Third, the instrument presents a strong local dependence between the easiest items, as many items were too easy. This could demonstrate that these items measure the same aspect and do not provide further information. This is especially visible for items in subcategory four, which describes the characteristics of a nurse. A final consideration about the scoring of the tests emerges by looking at the threshold ordering for each item. Only five items had the right order of thresholds, and the remaining 35 had reverse thresholds. Reverse thresholds are not a concern per se; they often are a consequence of low frequencies of the response categories observed and, in the presented case, they are a consequence of the low degree of difficulty of the items. Reverse thresholds highlight the opportunity of collapsing some response categories together (Wetzel & Carstensen, 2014), which in this case would mean treating the data as dichotomous by merging, for example incorrect and uncertain categories. In this study,

the full range of available data was used to closely reflect the actual scoring of the entrance exam, but in the future, the merging of the response categories could be considered.

While IRT provides quantitative insights on the performance of the instrument in measuring the latent construct, it is important to remember that the data was obtained from entrance exams, where the perception of the nursing applicants' is evaluated to specifically identify those applicants who have unrealistic perceptions of the nursing profession and who would be more likely to drop out of nursing education programmes. In addition, an entrance exam should have a variety of items with different item difficulty ranges. Also, redundant items are normal in the early stage of instrument development, and they can help identify those participants who are, for example, guessing (DeVellis, 2017).

The PNPI could be used outside the student selection setting to measure perceptions of the nursing profession. The PNPI could also be used in career counselling to support career choices in nursing, to identify information needs in society, to plan intervention studies that will influence the perception of the nursing profession and to upgrade the image of nursing in society to one that is more

professional. Moreover, the PNPI can be used for research purposes to study the perceptions of the nursing profession among possible nursing applicants and to measure and compare the perceptions of the nursing profession in different settings.

5.1 | Limitations

This study has some limitations. First, the perception of the nursing profession is an under-researched topic. Having more research conducted would ensure a richer description of the perception of the nursing profession as a theoretical framework for the instrument. Second, in the content validation process, the expert panel sizes were rather small; however, the minimum size suggested for the panel by the literature was gained. Third, purposive sampling was used in developing the theoretical framework for the PNPI, and it is possible that the nursing applicants who participated in the study do not represent the whole population of nursing applicants. However, the psychometric testing phase was carried out with a large sample size, and the sample represents the average nursing applicants in Finland well. Finally, the PNPI was developed in Finland, which might impact the generalizability of the study. The instrument needs to be validated in different cultural contexts because there are differences in the nursing profession and practice between the countries.

6 | CONCLUSIONS

The PNPI is a novel psychometrically sound and objective instrument for measuring perceptions of the nursing profession as a part of student selection in nursing education. The instrument has a strong theoretical framework and it demonstrated unidimensionality in the psychometric evaluation. However, some items showed a misfit; thus, a revision of those items is suggested. Additionally, the item difficulty level needs to be improved to enable better differentiation between low- and high-performing applicants, which is essential when using the instrument in the nursing student selection setting. The PNPI needs to be further developed and the IRT provides great insights for the development.

The PNPI can be used to screen the perceptions of possible nursing applicants and to support career choices in nursing. The PNPI makes it possible to measure perceptions and plan intervention studies that will influence perceptions of the nursing profession.

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CONFLICT OF INTEREST STATEMENT

No conflict of interest has been declared by the authors.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The authors have no rights to share the data. All R and Python software code used in this manuscript is openly shared at <https://github.com/eglerean/sulo>.



NO PATIENT OR PUBLIC CONTRIBUTIONS

This study aimed to develop an objective instrument to measure the perception of nursing profession among applicants to nurse education. The instrument was used in the national entrance examination in six universities of applied sciences in Finland. All the material related to the entrance exam was protected from the public and had to be kept secret from the potential nursing applicants. However, multiple persons outside the research team participated in the research process as study participants or as experts to evaluate the content of the instrument. Their participation and expertise were very valuable in developing the instrument.

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