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A short version of the nurse professional competence scale for measuring nurses' self-reported competence

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\textbf{A R T I C L E I N F O}

\textbf{Keywords:}
Nurses' competence
Nursing students' competence
Professional nursing
Nursing education
Validation
Psychometric properties

\textbf{A B S T R A C T}

\textbf{Background:} The Nurse Professional Competence (NPC) Scale with 88-items has been used to measure self-reported competence among nursing students and registered nurses in many national and international nursing research projects. However, a shorter version of the scale with maintained quality has been requested to further enhance its usability.

\textbf{Objectives:} To develop and evaluate the construct validity and internal consistency of a shorter version of the NPC Scale.

\textbf{Design:} A developmental and methodological design.

\textbf{Participants and Settings:} The study was based on a sample of 1810 nursing students at the point of graduation from 12 universities in Sweden.

\textbf{Methods:} The number of items in the original NPC Scale was reduced using several established research steps and then evaluated for data quality and construct validity using principal component analysis and confirmatory factor analysis. Reliability was measured as internal consistency using Cronbach’s alpha.

\textbf{Results:} The extensive process of reducing the number of items resulted in a version with 35 items. Principal component analysis resulted in six factors explaining 53.6% of the variance: “Nursing Care”, “Value-based Nursing Care”, “Medical and Technical Care”, “Care Pedagogics”, “Documentation and Administration of Nursing Care”, and “Development, Leadership, and Organization of Nursing Care”. All factors showed Cronbach's alpha values of > 0.70. The confirmative factor analysis goodness-of-fit indexes were for root mean square error of approximation 0.05 and for comparative fit index 0.89.

\textbf{Conclusions:} The NPC Scale Short Form (NPC Scale-SF) 35-items revealed promising results with a six-factor structure explaining 53.6% of the total variance. This 35-item scale can be an asset when used alone and together with other instruments it can provide the possibility of more complex analyses of self-reported competence among nursing students and registered nurses.

1. Background

In 2014, the Nurse Professional Competence (NPC) Scale for measuring self-reported professional competence among nursing students and registered nurses was published (Nilsson et al., 2014a). The NPC Scale consisted of 88-items and was based on competence requirements for registered nurses (RNs) published by the National Board of Health and Welfare in Sweden (The National Board of Health and Welfare, 2005) and WHO (2001). The 88-item version of the NPC Scale will henceforth be called the original NPC Scale.

The original NPC Scale measures nursing competence in the following eight competence areas, with Cronbach's alpha values ranging

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from 0.75 to 0.94 for the single competence area: Nursing Care, Value-based Nursing, Medical and Technical Care, Teaching/Learning and Support, Documentation and Information Technology, Legislation in Nursing and Safety Planning, Leadership in and Development of Nursing and Education and Supervision of Staff and Students. The eight competence areas construct two overarching themes: Patient-Related Nursing and Organization and Development of Nursing Care. Satisfactory results regarding data quality, validity and reliability was found when psychometric properties of the original NPC Scale were investigated (Nilsson et al., 2014a).

The original NPC Scale rapidly attracted national and international interest and it has been translated into six languages, including English (Nilsson et al., 2016a). The original NPC Scale has been used to assess self-reported competence among nursing students on the point of graduation (Gardulf et al., 2016), between students with or without international study experience (Nilsson et al., 2014b), and after curriculum changes to a three-year university program (Theander et al., 2016). The original NPC Scale has also been used to measure self-reported competence among RNs; conflict management (Leksell et al., 2015), competence to manage violence, serious events, and disasters (Nilsson et al., 2016b), and the effects of inter-professional education in prehospital emergency care (Castrèn et al., 2017). Within the European Network Nursing Academies (ENNA) project, the original NPC Scale is currently used in several countries with an intention to contribute to quality assessments and quality improvements in nursing education programs in Europe (European Network Nursing Academies (ENNA), n.d.). A recent literature review with the aim to identify a valid and reliable instrument for assessing professional nursing competence in Austria found among eight identified instrument that the original NPC Scale was the only instrument that responded to nationally defined competence categories (Kellerer et al., 2019).

Although the original NPC scale is appreciated and has already been used in several studies, international nursing researchers have also requested a shorter version. The response rate has been high in published studies using the original NPC Scale, but fewer items may potentially enhance high response rates further (Briller et al., 2012; Melnyk et al., 2012). This request for a shorter scale initiated a discussion within the NPC research group and a decision was made to commence the process of reducing the original 88-item NPC Scale without compromising quality. Another recognized advantage of a shorter scale is that it will be easier to combine with other instruments with the aim of providing more complex analyses of the self-reported competence of RNs and nursing students. The aim of the study was thus to develop and evaluate the construct validity and internal consistency of a shorter version of the NPC Scale.

2. Methods

2.1. Study Design

A developmental and methodological design including evaluation of the construct validity and internal consistency of a short form of the Nurse Professional Competence Scale.

2.2. Participants

The sampling was based on an invitation in 2012 and 2017, respectively, to all Swedish Higher Educational Institutions (HEI) providing nursing programs on Bachelor level. In 2012, 11 out of 25 HEIs and in 2017, 12 out of 25 HEIs participated.

Nursing students at the point of graduation from the three-year university education at the participating HEIs volunteered to answer the original 88-items NPC Scale. The response rates were high; in total 77% in 2012 and 71% in 2017. In total, 1810 nursing students participated. The respondents had a median age of 26 years (range 20–57, mean 28.2) and the majority were women (87.1%). The sample size of 1810 was large enough to assess construct validity by using principal component analysis (PCA) on half of the sample (n = 924) and confirmative factor analysis (CFA) on the other half (n = 886). The sample was split using a random number generator.

2.3. Data collection

A contact person at each HEI handed out the questionnaires to the students. The contact persons were available to answer questions and collected the questionnaires after completion. The questionnaire contained the original 88-item NPC Scale with response alternatives on a 4-point scale ranging from 1 ‘to a very low degree’ to 4 ‘to a very high degree’. There were also background questions for additional data.

2.4. Reduction of the number of items and data analysis

The original 88-item NPC Scale was reduced using two major analytic steps. The first step was to use the Pearson’s correlation coefficient to explore associations between items. All pairs of items with a high correlation (> 0.70) were discussed at length by the authors until a consensus was reached and the most relevant items kept. The second step was to perform a PCA where items with a factor loading below 0.4 were discarded (Tabachnick and Fidell, 2007).

2.5. Evaluation of psychometric properties

The 35-item NPC Scale was evaluated for data quality and construct validity using PCA and CFA. Initially, PCA was used to identify the underlying constructs of the 35-item NPC Scale, using orthogonal rotation (varimax) on half the sample (n = 924). The Kaiser-Meier-Olkin (KMO) measure was used to test for sampling adequacy. A value of > 0.6 for KMO is considered good (Tabachnick and Fidell, 2007). Scree-test and eigenvalues > 1.0 were used to determine the number of factors. Factor loadings of > 0.71 are considered excellent, > 0.63 very good, > 0.55 good, and > 0.45 fair. Only loadings of 0.32 or more should be interpreted (Tabachnick and Fidell, 2007). CFA was thereafter applied using IBM SPSS AMOS on the second half of the sample (n = 886). Goodness-of-fit indexes used were the Chi-square test (χ²), the Root mean square error of approximation (RMSEA), and the Comparative fit index (CFI) (Kline, 2005), thus using both absolute parameters (χ² test and RMSEA) and relative parameters (CFI). A non-significant χ² test is desirable. However, when using a large sample, as in the current evaluation, the χ² test is often significant and researchers therefore recommend using RMSEA (Kline, 2005). Values for RMSEA < 0.08 have been reported as acceptable, and values < 0.06 as good. For CFI, one of the most common relative parameters, a value > 0.90 is desirable (Kääriäinen et al., 2011). Reliability measured as internal consistency was evaluated using Cronbach’s alpha. Values of ≥ 0.70 were judged to be sufficient (Streiner and Norman, 2008).

IBM SPSS Statistics version 22.0 (SPSS Inc., an IBM Company, Chicago, IL, USA) was used to analyze data.

2.6. Ethical considerations

The deans/coordinators of the nursing programs at the included universities granted permission to perform the study. Informed consent was obtained from all students prior to filling in the questionnaire, which was done anonymously. The formal approval of an ethics committee was not required according to the Swedish Act on the Ethical Review of Research Involving Humans (Ministry of Education and Research, 2003), as no physical or psychological intervention was performed and no handling of sensitive personal data was necessary.

3. Results

The extensive process of reducing the number of items resulted in a total of 35 items which were further used in the analysis.
Medical and technical care, 6 items

Manage drugs and clinical application of knowledge in pharmacology 0.571
Independently administer prescriptions 0.716
Pose questions about unclear instructions 0.716
Support patients during examinations and treatments 0.684
Follow up on patient’s conditions after examinations and treatments 0.680
Handle medical/technical equipment according to legislation and safety routines 0.616

Care pedagogics, 5 items

Provide patients and relatives with support to enhance participation in patient care 0.668
Inform and educate individual patients and relatives 0.362
Inform and educate groups of patients and relatives 0.727
Make sure that information given to the patient is understood 0.698
Motivate the patient to adhere to treatments 0.524

Documentation and administration of nursing care, 8 items

Make use of relevant data in patient records 0.671
Use information technology as a support in nursing care 0.641
Document according to current legislation 0.655
Comply with current legislation and routines 0.682
Handle sensitive personal data in a safe way 0.683
Observe work-related risks and prevent them 0.586
Continuously engage in professional development 0.653
Lead and develop health staff teams 0.604

Development, leadership and organization of nursing care, 6 items

Act adequately in the event of unprofessional conduct among employees 0.535
Apply principles of disaster medicine 0.697
Search and review relevant literature for evidence-based nursing 0.690
Interact with other professionals in care pathways 0.721
Teach, supervise and assess students 0.795
Supervise and educate staff 0.786

α = Cronbach’s alpha. Only loadings > 0.32 are presented in the table for ease of interpretation. Bold entries indicate items included in the respective factor.

3.1. Data quality

The mean item score varied from 2.65 to 3.71 (standard deviation from 0.50 to 0.84) and the median item score from 3 to 4 (item range score was from 1 to 4 for all items). The proportion on an item level for the response alternative “To a very high degree” ranged between 12.2% (item 27) and 73.1% (item 9). For the response alternative “To a very low degree” the proportion ranged between 0.1% and 5.2%. Internal missing values ranged between 0.5% and 9.8% across all items. The highest proportion of missing values was seen for item 10 “To what extent are you able to contribute to a holistic view of the patient?”

3.2. Construct validity

3.2.1. Principal component analysis (PCA)

Using PCA resulted in a six-factor solution explaining 53.6% of the total variance. KMO was 0.920, which justified proceeding with the analysis. Factor loadings ranged from 0.428 to 0.795 (Table 1). Each factor was examined for content in the items and thereafter the six factors were named ‘Nursing Care’, ‘Value-based Nursing Care’, ‘Medical and Technical Care’, ‘Care Pedagogics’, ‘Documentation and Administration of Nursing Care’, and ‘Development Leadership and Organization of Nursing Care’. Three items (6, 20, 21) cross-loaded on two factors. Based on the content in item numbers 20 and 21, these were included in the factor “Care Pedagogics” (Table 1).

3.2.2. Confirmative factor analyses (CFA)

The six-factor solution for the NPC Scale was then tested using CFA on the second half of the sample (Fig. 1). Firstly, we ran the CFA with participants who had no missing data (n = 515) to examine modification indexes. The estimation method used was maximum likelihood (ML). Using the results from the modification indexes, we then re-ran the CFA (ML) on all 886 participants and allowed correlations between the six factors and between the error terms for items 2 and 3, items 4 and 5 and items 12 and 13 (Fig. 1). The items we allowed to correlate were excised in the same factors and based on content that was judged as reasonable. The χ² test was significant (Chi-square test 1871.33; d.f. 542; p < 0.001) which is common in a large sample. However, the RMSEA was 0.053, 90% confidence interval 0.050 to 0.055, which indicated a good fit, while CFI was 0.89 and did not reach the recommended value of > 0.90. Estimates of factor loadings are presented in Table 2 for the CFA using the ML method of estimation and for a CFA using the Bayesian method of estimation. The results mostly indicate stability when comparing the loadings.
Fig. 1. Flow chart presenting the underlying construct of the 35-item NPC-Scale (Error term [Er], item [I]).
3.3. Reliability

Reliability was measured as internal consistency for the six identified factors and ranged from 0.71 to 0.86 (Table 1). Factor scores were calculated by summing up items in each factor and dividing by the highest possible score in the factor and then multiplied by 100. Thus, factor scores were transformed to 0–100 values.

4. Discussion

An initial analytic process resulted in a 35-item version of the NPC Scale. This article presents the evaluation of the construct validity and internal consistency of this new 35-item NPC Scale – Short Form (NPC Scale-SF) to facilitate further use in evaluations and research regarding the self-reported professional competence of nursing students and RNs. On the basis of PCA, a theoretically sound six-factor structure for the NPC Scale-SF was obtained explaining 53.6% of the variance. This can be compared with the original 88-item version of the scale, which on the basis of an exploratory factor analysis resulted in eight factors explaining 48% of the total variance (Nilsson et al., 2014a).

The factors of the original 88-item NPC Scale were also found in the NPC Scale-SF 35-items and all Cronbach’s alpha-coefficients were > 0.70. In the original NPC Scale, factor 1 and factor 7 had alpha-coefficients above 0.90, which indicated that the number of items could be reduced. The alpha-coefficients in the 35-item NPC Scale-SF were all between 0.71 and 0.86, which indicated that the number of items was satisfactory.

The new NPC Scale-SF with its six factors contained all eight factors from the original NPC Scale (Table 3). The six factors were named "Nursing Care", "Value-based Nursing Care", "Medical and Technical Care", "Care Pedagogics", " Documentation and Administration of Nursing Care", and "Development, Leadership and Organization of Nursing Care". These six factors corresponded well with the new competence description developed by the Swedish Society of Nursing (2017) which in turn is structured according to the core competencies described by the Quality and Safety Education for Nurses (Sherwood and Zomorodi, 2014): patient-centered care, teamwork and collaboration, evidence-based practice, quality improvement, safety, and informatics. In the Swedish competence description leadership and care pedagogics are added as additional competencies, which are highlighted in policy documents directing international nursing (WHO, 2016; American Association of College of Nursing, 2016). In the 35-item NPC Scale-SF, the six competencies as well as care pedagogics and leadership are visible and can be captured when using the scale.

Although the response rate has been high in studies using the original NPC Scale with its 88-items, the NPC Scale-SF with its 35-items may further increase high response rates (Briller et al., 2012; Melnyk et al., 2012). Another advantage is that the NPC Scale-SF can be

### Table 2

<table>
<thead>
<tr>
<th>Items (n = 35)</th>
<th>Factor loadings ML*</th>
<th>Factor loadings, Bayesian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to...</td>
<td>ML</td>
<td></td>
</tr>
<tr>
<td>Nursing care, 5 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independently apply the nursing process</td>
<td>1.000</td>
<td>–</td>
</tr>
<tr>
<td>Meet patient's basic physical needs</td>
<td>0.886</td>
<td>0.886</td>
</tr>
<tr>
<td>Meet patient's specific physical needs</td>
<td>0.851</td>
<td>0.849</td>
</tr>
<tr>
<td>Document patient's physical status</td>
<td>1.021</td>
<td>1.013</td>
</tr>
<tr>
<td>Document patient's psychological status</td>
<td>0.987</td>
<td>0.979</td>
</tr>
<tr>
<td>Value-based nursing care, 5 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respectfully communicate with patients, relatives and staff</td>
<td>1.000</td>
<td>–</td>
</tr>
<tr>
<td>Show respect for patient autonomy, integrity and dignity</td>
<td>0.915</td>
<td>0.915</td>
</tr>
<tr>
<td>Enhance patients' and relatives' knowledge and experiences</td>
<td>0.878</td>
<td>0.884</td>
</tr>
<tr>
<td>Show respect for different values and beliefs</td>
<td>0.558</td>
<td>0.561</td>
</tr>
<tr>
<td>Contribute to a holistic view of the patient</td>
<td>1.079</td>
<td>1.079</td>
</tr>
<tr>
<td>Medical and technical care, 6 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage drugs and clinical application of knowledge in pharmacology</td>
<td>1.000</td>
<td>–</td>
</tr>
<tr>
<td>Independently administer prescriptions</td>
<td>1.225</td>
<td>1.242</td>
</tr>
<tr>
<td>Pose questions about unclear instructions</td>
<td>1.145</td>
<td>1.150</td>
</tr>
<tr>
<td>Support patients during examinations and treatments</td>
<td>1.270</td>
<td>1.277</td>
</tr>
<tr>
<td>Follow up on patient's conditions after examinations and treatments</td>
<td>1.272</td>
<td>1.279</td>
</tr>
<tr>
<td>Handle medical/technical equipment according to legislation and safety routines</td>
<td>1.245</td>
<td>1.251</td>
</tr>
<tr>
<td>Care pedagogics, 5 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide patients and relatives with support to enhance participation in patient care</td>
<td>1.000</td>
<td>–</td>
</tr>
<tr>
<td>Inform and educate individual patients and relatives</td>
<td>1.128</td>
<td>1.125</td>
</tr>
<tr>
<td>Inform and educate groups of patients and relatives</td>
<td>0.955</td>
<td>0.954</td>
</tr>
<tr>
<td>Make sure that information given to the patient is understood</td>
<td>1.087</td>
<td>1.085</td>
</tr>
<tr>
<td>Motivate the patient to adhere to treatments</td>
<td>0.873</td>
<td>0.869</td>
</tr>
<tr>
<td>Documentation and administration of nursing care, 8 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make use of relevant data in patient records</td>
<td>1.000</td>
<td>–</td>
</tr>
<tr>
<td>Use information technology as a support in nursing care</td>
<td>0.888</td>
<td>0.893</td>
</tr>
<tr>
<td>Document according to current legislation</td>
<td>0.888</td>
<td>0.900</td>
</tr>
<tr>
<td>Comply with current legislation and routines</td>
<td>1.219</td>
<td>1.228</td>
</tr>
<tr>
<td>Handle sensitive personal data in a safe way</td>
<td>1.245</td>
<td>1.257</td>
</tr>
<tr>
<td>Observe work-related risks and prevent them</td>
<td>0.952</td>
<td>0.962</td>
</tr>
<tr>
<td>Continuously engage in professional development</td>
<td>0.804</td>
<td>0.807</td>
</tr>
<tr>
<td>Lead and develop health staff teams</td>
<td>1.000</td>
<td>1.010</td>
</tr>
<tr>
<td>Development, leadership and organization of nursing care, 6 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Act adequately in the event of unprofessional conduct among employees</td>
<td>1.000</td>
<td>–</td>
</tr>
<tr>
<td>Apply principles of disaster medicine</td>
<td>1.588</td>
<td>1.586</td>
</tr>
<tr>
<td>Search and review relevant literature for evidence-based nursing</td>
<td>1.257</td>
<td>1.251</td>
</tr>
<tr>
<td>Interact with other professionals in care pathways</td>
<td>1.283</td>
<td>1.276</td>
</tr>
<tr>
<td>Teach, supervise and assess students</td>
<td>2.331</td>
<td>2.331</td>
</tr>
<tr>
<td>Supervise and educate staff</td>
<td>2.224</td>
<td>2.227</td>
</tr>
</tbody>
</table>

* Maximum likelihood (ML).
combined with more background factors as well as other instruments, which enables further complex analyses.

As previously reported, the original NPC Scale has been used to assess the outcomes of nursing education programs (Gardulf et al., 2016; Nilsson et al., 2016; Theander et al., 2016; Castrén et al., 2017), and to assess the professional competences of nurses in relation to the needs of healthcare organizations (Leksell et al., 2015; Nilsson et al., 2016b), which is also a valid use for the NPC Scale-SF. Additional uses of the NPC Scale-SF include designing introduction programs for newly employed nurses and competence development programs for RNs. Among nursing students the NPC Scale-SF could be an asset in developing self-regulated learning strategies. Using the NPC Scale-SF as a tool for self-evaluation and reflection could lead to it having an influence on critical thinking and the development of clinical reasoning skills (Kupier and Pesut, 2004).

To further develop the NPC Scale-SF, changing the number of response alternatives has been considered. Using 4-point response alternatives might reduce variation and thus affect the CFA. For future use of the 35-item NPC Scale-SF, seven response alternatives for each item could be considered. Streiner and Norman (2008) recommended the minimum number of response alternatives to be 5–7 to increase variability and reliability. Changes in reliability with 7-point or 10-point response alternatives are small, while a change to 5-point response alternatives reduces reliability by about 12% (Streiner and Norman, 2008). Our results using 4-point response alternatives revealed high values for several items (median 3 for 29 items and 4 for 6 items).

A strength of the present study was the use of both PCA and CFA to evaluate construct validity. Furthermore, both maximum likelihood and Bayesian method of estimation were used for estimates of factor loadings and showed, in general, stability in factor loadings for the CFA. As with all instruments, the NPC Scale-SF needs to be tested further when used in a new context, for example in another country.

As discussed earlier (Nilsson et al., 2014a), the research group is aware of the fact that the use of a nurse professional competence instrument will most probably result in the identification of competence gaps in nursing students and RNs. Making these gaps visible will result in the opportunity for both nurse educators and leaders of health care organizations to take action, which will contribute towards quality improvements to ensure quality of care and patient safety.

5. Conclusion

To conclude, the NPC Scale Short Form (NPC Scale-SF) 35-items revealed promising results with a six-factor structure explaining 53.6% of the total variance. This 35-item scale can be an asset when used alone as it stimulates a high response rate or together with other instruments where it could provide the possibility of more complex analyses of the self-reported competence of nursing students and registered nurses.

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Author Contribution


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