International Journal of Studies in Nursing; Vol. 4, No. 2; 2019
ISSN 2424-9653 E-ISSN 2529-7317
Published by July Press

Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN): Psychometric Evaluation

Hirokazu Ito[1], Tetsuya Tanioka[1], Mie Miyamoto[2], Misao Miyagawa[3], Yuko Yasuhara[1] & Rozzano C. Locsin[1]

[1] Department of Nursing, Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan

[2] Department of Nursing, Tokushima Prefectural Miyoshi Hospital, Tokushima, Japan

[3] Department of Nursing, Faculty of Health and Welfare, Tokushima Bunri University, Tokushima, Japan

Correspondence: Dr. Tetsuya Tanioka, Professor of Nursing, Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima university, Tokushima, Japan. Tel: 81-88-633-9021.

Received: March 18, 2019 Accepted: April 9, 2019 Online Published: April 15, 2019

doi:10.20849/ijsn.v4i2.562 URL: https://doi.org/10.20849/ijsn.v4i2.562

Abstract

Background: The theory of Technological Competency as Caring in Nursing (TCCN) was developed by Locsin (2005) to guide the expression of "technological competency as caring in nursing" among practicing nurses. While the Technological Competency as Caring in Nursing Instrument (TCCNI) was developed and translated into other languages, no instrument measuring the TCCN among Japanese nurses was developed and tested. Thus, the Perceived Inventory of Technological Competency of Caring in Nursing (PITCCN) was developed and improved. **Aim:** The aim of this study was to validate the PITCCN using construct validity through structural equation modeling (SEM). **Methods:** The PITCCN is a four-factor questionnaire. The PITCCN was distributed to four hospitals (402 nurses) from selected Shikoku District in Japan. The theoretical model was tested using confirmatory factor analysis (CFA). Exploratory factor analysis and CFA via a SEM were used to justify construct validity, and Cronbach's alpha coefficient was determined to establish reliability of constructs using SPSS and AMOS 25.0. **Results:** Finding shows that the chosen fit index test like Tucker Lewis Index (TLI), Goodness of Fit Index (GFI), and Normed Fit Index (NFI) are greater than 0.80 as set by the requirement. The values of the chi-square/degree of freedom (CMIN/DF), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and Root Mean Square of Error Approximation (RMSEA) showed acceptable to good fit. **Conclusion:** GFI of the structure model was acceptable.

Keywords: technological competency, caring, nursing, perceived inventory

1. Introduction

Since Mayeroff (1971) described caring in his book "On Caring," it has attracted attention in the nursing discipline. With caring, the shift in the focus of developing nursing knowledge from a positivistic view to a human science view provided the impetus to know persons more fully as caring persons, not just as the sum of composite parts, but as persons who continuously remain whole in the moment. What about the practice of nursing in which technological skillfulness is given high priority or recognition than to the affirmation, support, and celebration of the persons' humanness? In what ways do technologically competent nurses express caring? What do these recipients of care (patients) express as caring? Locsin (2005) has described nursing as "technological competency as caring in nursing" that is focused on the proficient practice of nurses using technologies to know persons more fully as caring, while affirming that being technologically competent is being caring. The general theory of Nursing as Caring by Boykin and Schoenhofer (2001) is the basis of Locsin's theory (2005).

In assessing and measuring caring for those in the nursing profession, Watson (2001) provided the essential research tools in her quintessential book. The measurement tools/instruments address quality of care, patient, client, and nurse perceptions of caring, and caring behaviors, abilities, and its efficacies. Two of the instruments that inform caring as identified by Watson (2001) are the Caring Assessment Report Evaluation Q-sort (CARE-Q) by Larson (1984), and the Caring Behaviors Inventory (CBI) by Wolf (1986) introduced as rating or perception of nurses' caring behavior. What is the best way to measure technological competency as caring in nursing?

2. The Purpose of the Study

The purpose of the study was to validate the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) using construct validity through confirmatory factor analysis (CFA), and its validity via structural equation modeling (SEM).

3. Review of the Literature

The theory of Technological Competency as Caring in Nursing (TCCN) was developed by Locsin (2005) to guide the expression of TCCN among practicing nurses. While the Technological Competency as Caring in Nursing Instrument (TCCNI) was developed by Locsin (1999), and Parcells and Locsin (2011). Biswas, Kongsuwan and Matchim (2016), Rincón-Álvarez and Chaparro-Díaz (2017) translated into other languages. However, there is no instrument measuring the TCCN among Japanese nurses was developed and tested. Considering culture and social background influencing measurement of these phenomena, Kato et al. (2017a, 2017b) focused their attention on developing and testing technological caring behaviors of nurses in acute care nursing by using the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) in the intensive care unit. Miyamoto et al. (2017) re-envisioned the TCCNI to focus on caring behaviors of nurses in acute care settings. The PITCCN has been made improvement on improvement by Tanioka and others (2018).

4. Method

4.1 The PITCCN

The TCCNI is focused on measuring technological competency as expression of caring in nursing. The TCCNI, thus far, was dedicated to measure the way of thinking of nurses as experts in technologies in health care practice. The TCCNI was found to have content validity (Biswas et al., 2016) and construct validity (Rincón-Álvarez & Chaparro-Díaz, 2017). Considering culture and social background in accurately measuring phenomena, Ms. Kato and other authors, under the leadership of Dr. Tetsuya Tanioka, focused on evaluating the recognition and status of practicing TCCN among nurses in the Intensive Care Units. While the TCCNI was dedicated to measure nurses' ways of thinking about caring and technology, the PITCCN was focused and tested on its contribution in practice

The Cronbach's alpha of all items of the PITCCN, with 300 Japanese nurses responding was 0.89. This indicated high internal consistency as found by Kato et al. (2017a). There awere negatively worded items (Q12, Q13, Q14, Q15, and Q22) in the PITCCN. The original PITCCN had 23 items. However, after Exploratory Factor Analysis, the latest model now has 19 items. Q7, 8, 13, and 14 were removed. The PITCCN was comprised of four factors: (1) Training of nurses to provide optimal care, (2) Empirical knowledge and whole human knowing, (3) Utilization of information obtained from technology and continuous knowing, and (4) Intentional and ethical nursing of person.

4.2 Analysis Method

All items were rated on a 5-point Likert scale which ranged from"1" as "Strongly Disagree" to "5" as "Strongly Agree". There were two major steps for performing the psychometric analysis:

• Step 1: Item analysis was performed to evaluate the internal consistency and discrimination ability of the scale. Descriptive statistics included the following: frequency distribution, percentage, mean, 95% confidence interval (CI) and standard deviation. Using expected scores to estimate the reliability of 95% CI was displayed visual representations. This 95% CIs of skewness values applied to item-by-item analyses can provide a useful interpretation of this research (Chien et al. (2010)). The p-value was set at <0.05, which indicated statistical significance.

• Step 2: Structural equation modeling (SEM) was employed to test the extent to which the measured variables represent the number of constructs and to confirm or reject the measurement theory. Some fit index tests, like the relative chi-square (CMINDF: the chi-square/degree of freedom), Tucker Lewis Index (TLI), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Normed Fit Index (NFI) and Root Mean Square of Error Approximation (RMSEA), are chosen in assessing model fit. Statistical analysis was done using SPSS and AMOS 25.0.

4.3 Ethical Considerations

This research study was approved by the Tokushima University Hospital Ethics Board (No. 2914). Furthermore, source of the PITCCN was shown.

5. Results

The PITCCN questionnaire copies were distributed in four hospitals (402 acute care nurses) from selected Shikoku District in Japan. Only 299 completed questionnaire copies were returned without missing values (response rate was 74.3%) (Table1). In particular, 72% of subjects did not receive education about caring.

Table 1. Characteristics of subjects (N=299)

Subjects		N=299	
Personal data		n	(%)
Gender	Male	13	(4%)
	Female	258	(87%)
	No response	28	(9%)
Age	Less than 20 years old	1	(0%)
	20-29 years old	136	(46%)
	30-39	70	(24%)
	40-49	58	(19%)
	over than 50 years old	34	(11%)
Clinical experience as nurse	Less than 1 years	6	(2%)
	1- less than 5 years	83	(28%)
	5- less than 10 years	59	(20%)
	10-less than 20 years	77	(26%)
	20 years or more	73	(24%)
	No response	1	(0%)
Existence of experience receiving education on caring	Yes	74	(25%)
	No	217	(72%)
	No response	8	(3%)
Education levels	Nurisng school	177	(59%)
	College (Nursing)	7	(2%)
	University (Nurising)	31	(11%)
	High School Advanced Course (Nursing)	81	(27%)
	Masters	3	(1%)

Table 2 shows the score of the PITCCN questionnaire. Especially for Q9, the mean and 95% confidence interval values were more than 4 points.

Table 2. Latest model of PITCCN and Demographic data (N=299)

N=299

No	Items	Mean	SD	Max	Min	95%CI
Q1	I assess patient's condition from information acquired using technology.	3.59	0.93	5	1	3.48 - 3.70
Q2	I understand the condition of their patients based on information acquired from technology.	3.51	0.91	5	1	3.40 - 3.62
Q3	I share patient information acquired from technology to illustrate team medical care, effectively.	3.58	0.93	5	1	3.47 - 3.69
Q4	I use knowledge of anatomy and physiology.	3.57	0.79	5	1	3.47 - 3.66
Q5	I use knowledge of latest clinical pharmacology.	2.89	0.82	5	1	2.80 - 2.99
Q6	I use knowledge of well-versed in the state-of-the-art of medical devices in their department.	3.42	0.82	5	1	3.32 - 3.52
Q9	I respect patients as unique individuals.	4.20	0.80	5	1	4.10 - 4.29
Q10	I know the whole patient.	3.69	0.74	5	1	3.60 - 3.78
Q11	I encourage patients by caring emotionally.	3.65	0.72	5	2	3.56 - 3.74
Q12	I am caring patients with unchanged attitude even if patients lose their physical functions.	3.90	0.79	5	1	3.80 - 3.99
Q15	I encourage patients by touching their body.	3.82	0.80	5	1	3.72 - 3.92
Q16	I care for patients considering time and situation.	3.82	0.67	5	2	3.74 - 3.90
Q17	I provide the best nursing care for patients.	3.64	0.72	5	1	3.56 - 3.73
Q18	I behave in ways to can gain the trust of patients.	3.97	0.69	5	2	3.89 - 4.05
Q19	I continue to consider better care by reflecting on their process of care.	3.71	0.73	5	1	3.62 - 3.79
Q20	I support patients in order to fulfill patients' hopes and desires.	3.80	0.63	5	2	3.72 - 3.87
Q21	I practice like growing up as nurse.	3.63	0.73	5	2	3.54 - 3.72
Q22	I cherish that to convey patient what I learned from patients and to share with patients.	3.52	0.79	5	1	3.42 - 3.61
Q23	I communicate their learned experiences of caring for patients with their colleagues and nursing students, and share with them.	3.44	0.91	5	1	3.33 - 3.55

SD: standard devision, Max: Maximam, Min: Minimam, CI: Confidence Interval

There are negatively worded items (Q12, Q15, and Q22) in the PITCCN.

Figure 1 shows the verification of the structure model of the PITCCN after considering all statistical fit index tests and modification index. Modification index has to be considered in order to obtain the required value for fit index test of TLI and NFI. To increase these fit index values then item Q23 was deleted in order to reduce the discrepancy value.

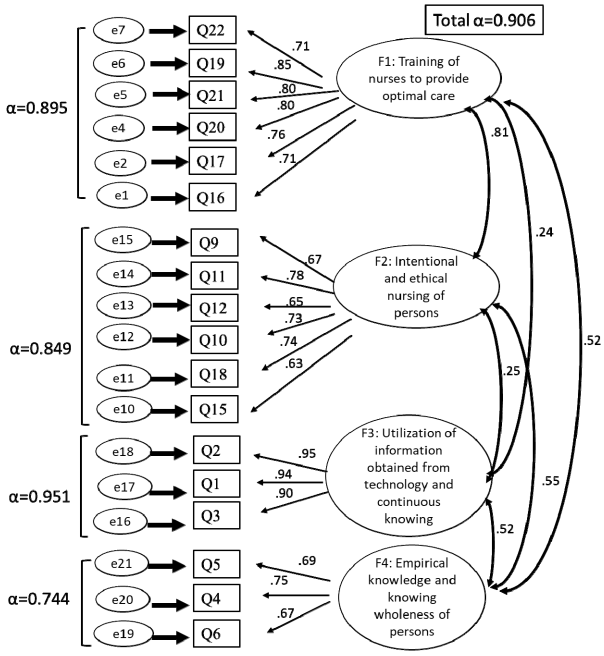

Figure 1. PITCCN four- dimensional factorial framework

Finding shows that the chosen fit index test like TLI, GFI, and NFI are greater than 0.80 as set by the requirement. In addition, the values of CMIN/DF, CFI, IFI and RMSEA have achieved the acceptable fit as shown in Table 3.

Table 3. Model fit indices for the PITCCN

Fit Index	CMIN/DF	TLI	GFI	AGFI	CFI	IFI	NFI	RMSEA
Value	2.659	0.922	0.891	0.855	0.934	0.935	0.899	0.075

CMIN/DF (the chi-square/degree of freedom), Tucker Lewis Index (TLI), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Normed Fit Index (NFI) and Root Mean Square of Error Approximation (RMSEA)

6. Discussion

The central concept of PITCCN was influenced by patterns of knowing in nursing as identified and described by Carper (1978). These are empirics, personal, ethics, and aesthetics. In addition, PITCCN has assumed empirical knowing as a process to understand persons using technologies contributing to the scientific knowledge to support nursing interventions. The PITCCN is constituted of four factors: (Factor 1) Training of nurses to provide optimal care, (Factor 2) Intentional and ethical nursing of person, (Factor 3) Utilization of information obtained from technology and continuous knowing, and (Factor 4) Empirical knowledge and knowing wholeness of persons. PITCCN measures the practical situation, high score question items are important for all nurses practice. Especially for Q9, the mean and 95% confidence interval values ware over than 4 points. This is considered evidence that respondents think is very important.

The model fit indices were discussed below.

CMIN (χ^2 value): It is an index with the null hypothesis that the model is correct. CMIN = 342.96, DF = 129, $p < 0.001$. The conformity is not good only with CMIN. However, there are no problems with other values that don't

depend on sample size. Values are TLI = 0.922, GFI = 0.891, AGFI = 0.855, CFI = 0.934, and NFI = 0.899, these means satisfactory fit. RMSEA = 0.075 (90%CI = 0.065-0.084), this shows acceptable fit the model. Accordingly, the goodness-of-fit of the corrected structure model was acceptable. From these four factors model, it was considered that PITCCN is able to measure technological competency as expression of caring in nursing.

Boykin and Schoenhofer (2001) believe that the knowing in nursing is embedded within the nursing situation, which is defined as a shared lived experience in which the caring between nurse and nursed enhances personhood. Also, Watkins (2000) mentioned that novice nurses are struggling for the existence of gaps between theory and practice. It is beneficial to measure if theory and practice are associated.

PITCCN is not a way of thinking but a measure of practice situation. Therefore, the content is started by "I am…" Utilizing this scale in the future, this instrument will be able to measure the practice situation of nursing as an experienced nurse or a novice nurse's care. PITCCN can also be used to measure effectiveness of in-service education in general hospitals.

PITCCN is a scale that can measure the practical situation of nursing based on TCCN theory. Therefore, by using this PITCCN, nurses can reflect on whether or not they could practice nursing based on this theory. It is thought that the instrument can be utilized as an important tool that can evaluate the growth of professional nurses. However, these findings remain relevant only to the Japanese hospital settings, although recommendations focus on replicating this study to determine the PITCCN reliability and validity using other languages in other countries.

Papastavrou et al. (2012) mentioned that nurses' professional practice environment had difficulties related to demographic, cultural, health system differences, and the way in which nursing is defined in each country.

Therefore, when targeting nurses from various countries with different cultural background, religion, medical level, the assumption is that the results will be different. The knowledge about caring and the state of development of technology also influence the answer result.

Turale (2011) mentioned that in the situation of technology related to nurses, there are differences from country to country, also, there is a difference in education. In the future, PITCCN needs to be verified in various countries

7. Conclusions

The study found that the PITCCN was valid and reliable in measuring TCCN. As such, the instrument can be used to determine patients' evaluation of technological competency as caring in nursing. In particular settings, this instrument can be used in general hospitals to measure the state of nursing practicing using TCCN of nurses. In addition, it may be able to lead the way towards expressing quality improvement of nursing and its practice with technologies by genuinely knowing persons as continually whole human beings, and measuring nursing practice situation based on Locsin's TCCN theory.

Acknowledgements

We would like to express our deep gratitude to the Japanese nurses and nursing administrators who participated in this study.

This work was supported by JSPS KAKENHI Grant, Number 15K15798.

References

Biswas, R. S., Kongsuwan, W., & Matchim, Y. (2016). Technological Competency as Caring in Nursing as Perceived by ICU Nurses in Bangladesh and Its Related Factors. *Songklanagarind Journal of Nursing, 36*(1), 1-20.

Boykin, A., & Schoenhofer, S. (2001). *Nursing as caring: A model for transforming practice.* Sudbury, MA: Jones and Bartlett Publishers.

Carper, B. A. (1978). Fundamental patterns of knowing in nursing. *Advances in Nursing Since*, *1*(1), 13-24. https://doi.org/10.1097/00012272-197810000-00004

Chien, T. W., Lin, S. J., Wang, W. C., Leung, H. W., Lai, W. P., & Chan, A. L. (2010). Reliability of 95% confidence interval revealed by expected quality-of-life scores: an example of nasopharyngeal carcinoma patients after radiotherapy using EORTC QLQ-C 30. *Health and Quality of Life Outcomes*, *8*(68), 1-8. https://doi.org/10.1186/1477-7525-8-68

Kato, K., Miyagawa, M., Yasuhara, Y., Osaka, K., Kataoka, M., Ito, H., & Waraporn, K. (2017b). Recognition and Status of Practicing Technological Competency as Caring in Nursing by Nurses in ICU. *International*

Journal of Nursing & Clinical Practices, *4*(1), 264. https://doi.org/10.15344/2394-4978/2017/264

Kato, K., Tanioka, T., Yasuhara, Y., Miyagawa, M., Osaka, K., Kataoka, M., & Locsin, R. (2017a). The Development of the Perceived Inventory of Technological Competency as Caring in Nursing. *SHIKOKU ACTA MEDICA*, *73*(3, 4), 151-160.

Larson, P. J. (1984). Important nurse caring behaviors perceived by patients with cancer. *Oncol Nurs Forum*, *11*(6), 46-50.

Locsin, R. (1999). Development of an instrument to measure technological caring in nursing. *Nursing and Health Sciences*, *1*(1), 27-34. https://doi.org/10.1046/j.1442-2018.1999.00005.x

Locsin, R. (2005). *Technological competency as caring in nursing: A model for practice*. Indianapolis, IN: Sigma Theta Tau International.

Mayeroff, M. (1971). *On caring*. New York, NY: Harper Perennial

Miyamoto, M., Miyagawa, M., Tanioka, T., Yasuhara, Y., Locsin, R., Osaka, K., & Waraporn, K. (2017). Comparative Examination between the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) and the Technological Competency as Caring in Nursing Instrument (TCCNI). *International Journal of Nursing & Clinical Practices*, *4*(1), 267. https://doi.org/10.15344/2394-4978/2017/267

Papastavrou, E., Efstathiou, G., Acaroglu, R., DA Luz, M. D., Berg, A., Idvall, E., & Suhonen, R. (2012). A seven country comparison of nurses' perceptions of their professional practice environment. *Journal of Nursing Management*, *20*, 236-248. https://doi.org/10.1111/j.1365-2834.2011.01289.x

Parcells, D. A., & Locsin, R. (2011). Development and psychometric testing of the technological competence as caring in nursing instrument. *International Journal for Human Caring*, *15*(4), 8-13. https://doi.org/10.20467/1091-5710.15.4.8

Rincón-Álvarez, D. A., & Chaparro-Díaz, L. (2017). Validity and Reliability of the Spanish Version of the Technological Competencyas Caring in Nursing Instrument. *Invest Educ Enferm, 35*(2), 154-164. https://doi.org/10.17533/udea.iee.v35n1a04

Tanioka, T. (2018). The Theory of Technological Competency as Carig in Nursing and Its Instruments (TCCNI) Within the Japanese Nursing System: Futurist Developments and Utilization. In Locsin, R., & Warapon, K. (Eds.), *The Evolution of the Theory of Technological Competency as Caring in Nursing: A middle-Range Theory of Nursing* (pp. 145-154). Hatyai, Thailand: Chanmuang press.

Turale, S. (2011). Technology and its Impact on Nursing Education. *Journal of Nursing Science, 29*(1), 9-17.

Watkins, M. J. (2000). Competency for nursing practice. *Journal of Clinical Nursing*, *9*(3), 338-346. https://doi.org/10.1046/j.1365-2702.2000.00402.x

Watson, J. (2001). *Assessing and measuring caring in nursing and health sciences*. New York, NY: Springer Publishing Company.

Wolf, Z. R. (1986). The caring concept and nurse identified caring behaviors. *Topics in Clinical Nursing*, *8*(2), 84-93.