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USING THE HYBRID MCDM MODEL TO IMPROVE THE NEW NURSE EDUCATION PROGRAM AT ONE TEACHING HOSPITAL

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Abstract

Many new nurses resign during their transition period in hospitals. To investigate the most influential factors that affect new nurses and make suggestions for how transition education programs can be improved to prevent nurses from leaving the profession. A hybrid multiple-criteria decision-making method was used. The largest performance gap between the criteria and their aspired levels was evident for the content dimension. This study discovered that content was affected by context and social aspects. Context and social aspects were thus identified as the priority in this case study. That the largest gap was for content could suggest that strategies for improving organizational socialization should focus on changing education program content; however, this approach would not solve the fundamental problem. Because content is affected by context and social aspects, these two dimensions should be improved first.

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Key Words: MCDM, New Nurse, Organizational Socialization, Improvement Strategy

Introduction

The proportion of older and more senior nurses who are retiring is increasing due to demographic changes (Thébault et al., 2012; Laschinger et al., 2016), resulting in a shortage of nursing personnel worldwide and continuous growth of health care needs (Kinghorn et al., 2017). Taiwan has long been plagued by a shortage of nursing personnel, with the lack of staff and resultant higher workload becoming a vicious cycle. The shortage and mobility of nurses have become a major problem in the medical care system.

The greatest problems among nurses are their limited work experience and not uniformly high nursing capabilities, which result in their failure to approach their work with professional capability, thereby affecting the quality of care (Chan et al., 2013). In addition, nurses are constantly under high working pressure, heavy workload, and irregular work hours, causing burn out and leading to a high turnover and frequent movement between departments (Ackerson and Stiles, 2018). Organizational socialization is the process of newcomer transformation, and successful organizational socialization can reduce the feeling of work pressure. Kowtha, 2018).

Studies on this topic have mostly focused on the causal and differential relationships between the aforementioned variables, with few studies using multiple-criteria decision- making (MCDM) to propose improvement strategies (Sun, 2014; Taati and Esmaili Dooki, 2017). Therefore, MCDM was adopted in the present study to construct improvement strategies for the transition education program of new nurses; this investigation would expand the academic contribution of MCDM to the field of nursing practice.

Design Theory and Literature Review

The improvement strategies were then improved upon on the basis of the interdependence of and feedback between evaluation criteria. Jones (1986) studied the socialization strategies adopted by organizations and the relationship between individual roles and personal outcome, examining the effects of self-efficacy on role orientation. The research framework of the present study was based on the six organizational socialization strategies proposed by Van Maanen and Schein (1979), and the framework was divided into three dimensions, namely context, content, and social aspects, which are now described.

1. Context

Context focuses on the training environment that organizations provide to newcomers, and strategies aimed at this dimension are collective and individual. Through collective strategies, newcomers are separated from the current staff members during socialization, after which the newcomers are gathered and subject to standardized training to reduce their sense of uncertainty in new environments (Bengtson et al., 2013). Therefore, collective strategies give newcomers space in

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which to accept the status quo and accept their practical tasks or roles as well as learn the necessary job skills (Rush et al., 2013).

Newcomers who receive centralized training learn the common norms, values, and attitudes of their organization in a planned environment, and the interaction and communication between newcomers amplify the environmental atmospheres that are planned for the newcomers by the organization (Liao et al., 2017; Livi et al., 2018). Conversely, individual strategies provide each newcomer with a tailor-made learning experience, deploying them separately to different units. Once a newcomer understands their role, they can decide how to perform tasks based on the approaches that are most suitable for them (Jones, 1986).

Favorable interaction with supervisors and colleagues can increase newcomers' trust toward their organization, thereby reducing the anxiety resulting from joining a new environment (Lapointe et al., 2014). Because nursing staff are continuously leaving the profession or being sent from one unit to another, the transfer of professional knowledge and techniques to the new nurses who must take over has become crucial if the operation of medical services is to be sustainable (Thébault et al., 2012).

2. Content

Content refers to the information provided by organizations to newcomers through socialization, and strategies aimed at this dimension are sequential and random. Sequential strategies provide newcomers with clear information

regarding the activities or training that they will experience in the organization in the future, as well as schedules for each stage, for which training will be implemented accordingly (Lee et al., 2013). Standard operation procedure developed for clinical nurse specialists to perform their practices can ensure procedure continuity certainty and increase patient satisfaction (Naegele et al., 2015). For nurses, a favorable working environment is a place in which they can invest in their future career development and continually develop a professional working environment (Price and Reichert, 2017).

Conversely, variable socialization strategies do not provide newcomers with any information regarding when they will reach a certain stage during the learning process. Despite the uncertainty of random socialization resulting in higher anxiety for newcomers, if they can actively acquire more information from their workplace (Kramer, 2010), they will become capable of coping with uncertain socialization in the future. In other words, random strategies can encourage newcomers to face environmental changes by using innovative approaches (Bennett et al., 2012).

3. Social Aspects

Social aspects are the social and interpersonal aspects of organizational socialization, and strategies aimed at this dimension are serial and disjunctive. The primary sources of information in the process of organizational socialization are top management, supervisors, colleagues, and subordinates (Hart, 2016). During serial socialization, seasoned organizational members act as role models for new employees,

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giving the newcomers active social support (Raymond et al., 2018).

Regarding interpersonal relationships, the opinions provided by other organizational members based on their experience may be more influential on the newcomers' perception of their surroundings than objective environmental factors (Atherley et al., 2016; Kramer, 2010). In disjunctive socialization, new members are not provided social support from other organizational members; instead, they must formulate their own situational definitions given that they are lacking senior role models. The newcomers have the responsibility of viewing themselves as a crucial factor in the socialization process and should work together with the organization to facilitate a favorable socialization outcome (Delobbe et al., 2016).

This study has reviewed the literature to develop an evaluation framework and then confirm these important dimensions and criteria with pre-test questionnaires of experts. The evaluation model, with the three dimensions, has fifteen criteria to be selected in Table 1.

Method

A hybrid MCDM model was used and the questionnaire survey in this study was conducted. This study focused on a teaching hospital in southern Taiwan. To ensure the expert validity of the questionnaire, the pretest was adopted and thus consensus of an expert group acquired regarding the evaluation criteria. To enhance the heterogeneity of the expert team in this study, nurses from different units of the nursing department who were involved in the organizational socialization of new nurses were recruited as participants. They included the director and supervisor of the nursing department, the head nurse, and senior nurses. The research method employed in this study was the hybrid MCDM model, which includes Decision-Making Trial and Evaluation Laboratory (DEMATEL), DEMATEL-based ANP (DANP), and VIšekriterijumsko Kompromisno Rangiranje (VIKOR).

1. DEMATEL

DEMATEL was applied soon after its proposal to solution of complex problems related to engineering systems (Fontela and Gabus, 1976; Gabus and Fontela, 1973). Because of its continual development, DEMATEL has been widely applied by scholars in medical fields (Si et al., 2017; Taati and Esmaili, 2017; Lin et al., 2019). In this study, the extent to which the criteria affected each other was evaluated through pairwise comparison. The $n \times n$ average influence matrix (A) can be obtained, shown as Eq. (1). The degree of influence of criterion i on criterion j is denoted by a_{ij}.

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1j} & \cdots & a_{1n} \\ \vdots & & \vdots & & \vdots \\ a_{i1} & \cdots & a_{ij} & \cdots & a_{in} \\ \vdots & & \vdots & & \vdots \\ a_{n1} & \cdots & a_{nj} & \cdots & a_{nn} \end{bmatrix} \quad (1)$$

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Table 1. Dimensions and Criteria for Evaluating the New Nurse Transition Program.

Dimensions	Criteria	Descriptions
Context (D_1)	Centralized training (C_{11})	New nurses are gathered in one location for training.
	Standardized training (C_{12})	New nurses receive standardized pre-employment training.
	Training process (C_{13})	The pre-employment training is complete and nondispersive.
	Workflow (C_{14})	New nurses must be familiar with the workflow.
	Job skills (C_{15})	New nurses acquire the necessary skills for clinical work.
Content (D_2)	Standardized operating procedures (C_{21})	Standard operating procedures for workflows are available.
	Promotion approach (C_{22})	The organization has a clear path for promotion.
	Work vision (C_{23})	The work vision for nursing is challenging.
	Training schedule (C_{24})	A complete and clear training schedule is provided.
	Transparency (C_{25})	There is transparency in personnel and decision-making matters.
Social Aspects (D_3)	Social support (C_{31})	Supervisors and senior colleagues are friendly.
	Work adaptation (C_{32})	Senior colleagues are willing to assist in work adaptation.
	Experience exchange (C_{33})	Colleagues exchange information on their work experience.
	Duty fulfillment (C_{34})	The duties and obligations of nurses are fulfilled.
	Favorable interaction (C_{35})	The organizational atmosphere is favorable.

Normalized influence matrix (V) can be obtained from Eq. (2) and (3).

$$V = A/m \qquad (2)$$

$$m = \max\left[\max_{1\le i\le n}\sum_{j=1}^n a_{ij}, \max_{1\le j\le n}\sum_{i=1}^n a_{ij}\right]. \qquad (3)$$

Total influence matrix (Y) can be obtained from Eq. (4), I is a $n \times n$ unit matrix.

$$\begin{aligned}Y &= V + V^2 + V^3 + \cdots + V^h \\ &= V(I-V)^{-1}, \\ &\text{as } h \to \infty, V^h = [0]_{n\times n}\end{aligned} \qquad (4)$$

The total influence matrix Y of INRM can derived by using Eq. (5) and (6) to generate each row sum (r)

and column sum (s).

$$r = \left[\sum_{j=1}^n y_{ij}\right]_{n\times 1}, i,j = 1,2,\cdots,n \qquad (5)$$

$$s = \left[\sum_{i=1}^n y_{ij}\right]_{1\times n}, i,j = 1,2,\cdots,n \qquad (6)$$

The analytic network process (ANP) was first proposed by Saaty in 1996 with the purpose of optimizing the interdependence assumption to reflect the real-world relationships between attribute dependence and feedback between each factor. Ou Yang et al. (2008) used DANP to acquire the dynamic relationships between criteria, enabling construction of a model that

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is in greater agreement with the real-world situation. Because the factors in this study were highly correlated, DANP was adopted to acquire the influential weights of each criterion.

The steps of the DANP technique are described as follows:

Step 1: The normalized total influence matrix QUOTE $c^{\boxed{a}}$ T^{α} can be obtained, shown as Eq. (7). Eq. (8) is used to transpose matrix T^{α} into matrix W.

$$T^{\alpha} = \left[t_{ij}\right]_{n \times n} / u \qquad (7)$$

$$W = (T^{\alpha})^{-1} \qquad (8)$$

Step 2: The matrix W, as shown in Eq. (9), is multiplied by itself β times to obtain the limit matrix. That is, the DANP weights of each criterion can be acquired. W_D^l is multiplied by W_C^l, and the global weight W^g of all criteria is obtained (influential weight, IW), shown as Eq. (10).

$$W^l = \lim_{\beta \to \infty} (W)^{\beta} \qquad (9)$$

$$W^g = W_D^l \times W_C^l \qquad (10)$$

2. VIKOR

VIKOR is a multisolution ordering method proposed by Opricovic (1998) with the purpose of resolving conflicting solutions through compromise. Liou et al. (2011) proposed modified VIKOR, the basic concept of which is to establish the gaps in priorities between alternatives and as-

pired-levels. The approach replaces the conventional VIKOR, which focuses solely on determining the optimal solution from the max–min values of performance values of existing solutions. Modified VIKOR can provide the space and direction for improvement based on the gap between the alternatives and aspired levels of each solution. Next, the influential weights of DANP were incorporated into the computation of modified VIKOR to derive the gap between each criterion and the aspired level (Chou et al., 2016). Finally, the priorities of the organizational socialization criteria for new nurses were identified using a holistic and visual approach, the INRM, and a systematic improvement strategy was developed that, if applied in the hospital, could achieve fundamental reform (Lu et al., 2013). The VIKOR method can identify individual gaps in criteria by using Eq. (11). The symbol of f^* represents the positive ideal solution, and f^- represents the negative ideal solution. Here, w_j^g indicates the IW.

$$r_{kj} = \left(\left|f^* - f_{kj}\right|\right) / \left(\left|f^* - f^-\right|\right) \quad (11)$$

$$S_k = \sum_{j=1}^{n} \left(W_j^g \times r_{kj}\right) \qquad (12)$$

3. Empirical Case

(1) Background and Data Collection

The teaching hospital A facing problem regarding the high rate of new nurse turnover has dedicated its efforts to provide high quality healthcare.

The pretest was adopted and thus consensus of an expert group acquired regarding the evaluation criteria. To enhance the heterogeneity of the expert

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team in this study, nurses from different units of the nursing department who were involved in the organizational socialization of new nurses were recruited as participants. They included the director and supervisor of the nursing department, the head nurse, and senior nurses.

Data collection was divided into two stages, the first of which was the pretest. First, the dimensions, criteria, and definition of the organizational socialization of the new nurses were compiled based on a literature review, and the evaluation criteria were then revised and adjusted. During the pretest, the participants were requested to answer items based on their importance. The questionnaire survey in the pretest involved five experts: a professor familiar with the organizational socialization of new nurses and four supervisors from the surveyed hospital. The purpose of the pretest questionnaire was to determine the key dimensions and indicators for the organizational socialization of new nurses. In the second stage of data collection, a questionnaire survey was conducted with an expert group. Because of the complexity of the questionnaire, the author conducted the survey face-to-face with the expert group to assist them in answering the questionnaire, with the questionnaire requiring approximately 60 minutes for each participant to complete. A total of nine questionnaires were distributed to the expert group, which included the five experts who participated in the pretest.

(2) Data Analysis

The total influence matrix was obtained through the calculation procedure of the DEMATEL method. Summation of the rows yields r, the influence of a particular criterion on the other criteria; similarly, summation of the columns yields s, which denotes the influence exerted on a particular criterion by the other criteria. Next, the total influence of each criterion was determined; the results are displayed in Table 2. In the table, $(r + s)$ represents the total strength of the influence exerted by and on a criterion, whereas $(r - s)$ denotes the total extent to which a criterion influences the other criteria.

Table 2. Influence of the dimensions/criteria and performance gaps.

Dimensions/Criteria	$r + s$	$r - s$	weights	Gap
Context (D_1)	1.91	0.17		0.28
Centralized training (C_{11})	9.92	-1.42	0.08	0.78
Standardized training(C_{12})	9.64	0.59	0.06	0.15
Training process (C_{13})	9.24	1.22	0.05	0.12
Workflow (C_{14})	9.43	1.77	0.05	0.10
Job skills (C_{15})	9.58	2.15	0.05	0.03
Content (D_2)	2.02	-0.19		0.55
Standardized operating procedures (C_{21})	10.33	-0.51	0.07	0.15
Promotion approach (C_{22})	9.64	-1.94	0.08	0.74
Work vision (C_{23})	10.12	-0.86	0.07	0.62
Training schedule (C_{24})	10.24	-0.37	0.07	0.54
Transparency (C_{25})	10.11	-1.01	0.07	0.67

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Social aspects (D_3)	2.02	0.02		0.32
Social support (C_{31})	10.16	−0.25	0.07	0.40
Work adaptation (C_{32})	10.07	0.19	0.07	0.32
Experience exchange (C_{33})	10.22	0.18	0.07	0.25
Duty fulfillment (C_{34})	10.06	−0.17	0.07	0.45
Favorable interaction (C_{35})	10.01	0.42	0.06	0.17

The INRM was then obtained by taking the $(r + s)$ and $(r - s)$ of a factor as values for plotting along the X-axis and Y-axis, respectively. According to the $(r - s)$ of the INRM of dimensions and criteria (Fig. 1), the level of influence of the dimensions in descending order was context (D_1, 0.17), social aspects (D_3, 0.02), and content (D_2, −0.19).
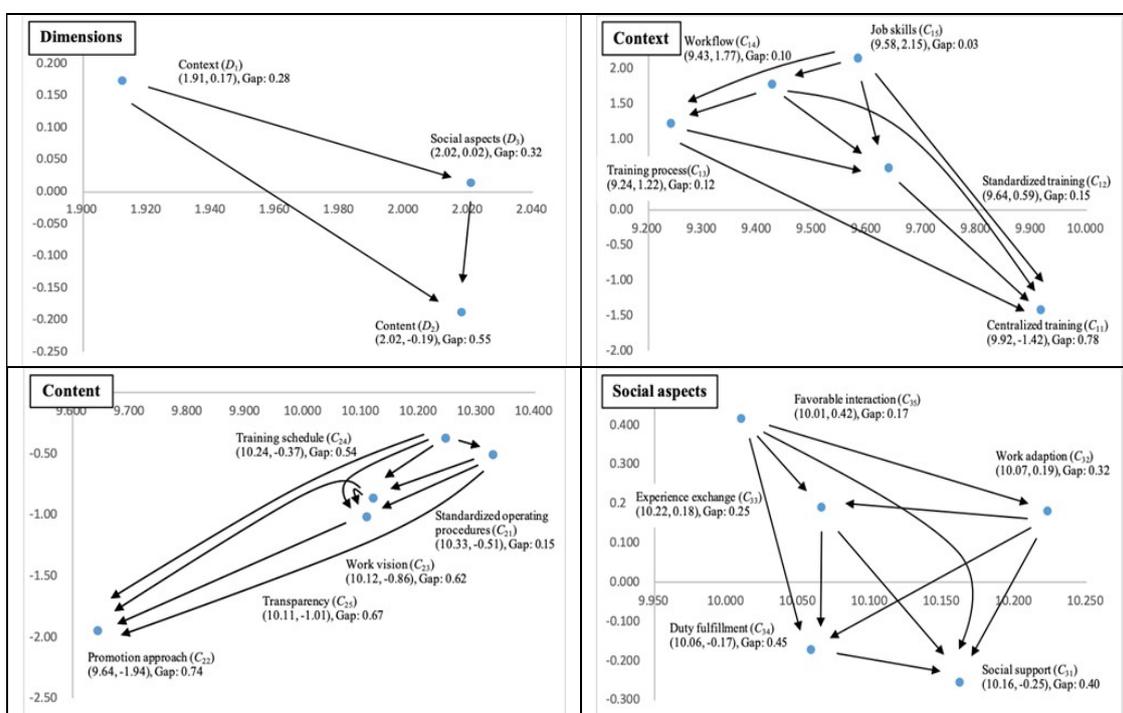

Figure 1. INRM of Dimensions and Criteria

According to the $(r - s)$ of the INRM of context, the level of influence of the context criteria in descending order was job skills (D_{15}, 2.15), workflow (D_{14}, 1.77), training process (D_{13}, 1.22), standardized training (D_{12}, 0.59), and centralized training (D_{11}, −1.42). According to the $(r - s)$ of the INRM of content, the level of influence of the content criteria in descending order was training schedule (C_{24}, −0.37), standardized operating procedures (C_{21}, −0.51), work vision (C_{23}, −0.86), transparency (C_{25}, −1.01), and promotion approach (C_{22}, −1.94). According to the $(r - s)$ of the INRM of social aspects, the level of influence of each social aspect criterion in descending order was favorable interaction (C_{35}, 0.42), work adaptation (C_{32}, 0.19), experience exchange, (C_{33}, 0.18), duty fulfillment (C_{34}, −0.17), and social support (C_{31}, −0.25).

DANP was used to obtain the weights of the criteria. Subsequently, the expert group employed VIKOR to assess organizational socialization performance, the results of which were combined with the global weights to acquire an evaluation of the performance of the case study by using modified VIKOR; the findings are presented in Table 2. Based on the resulting gap values, the performance in the three dimensions in descending order was content (D_2, 0.55), social aspects (D_3, 0.32), and context (D_1, 0.28). The aspirational gaps of the five criteria of context (D_1) in descending order were 0.78 for centralized training (C_{11}), 0.15 for standardized training (C_{12}), 0.12 for training process (C_{13}), 0.10 for workflow (C_{14}), and 0.03 for job skills (C_{15}). The aspirational gaps of the five criteria of content (D_2) in descending order were 0.74 for promotion approach (C_{22}), 0.67 for transparency (C_{25}), 0.62 for work vi-

sion (C_{23}), 0.54 for training schedule (C_{24}), and 0.15 for standardized operating procedures (C_{21}). The aspirational gaps of the five criteria of social aspects (D_3) in descending order were 0.45 for duty fulfillment (C_{34}), 0.40 for social support (C_{31}), 0.32 for work adaptation (C_{32}), 0.25 for experience exchange (C_{33}), and 0.17 for favorable interaction (C_{35}).

Discussion

The results from the hybrid MCDM model indicate that the gap is greatest for content (D_2), and conventional thinking would propose the direct improvement of content (D_2). However, this approach would not solve the fundamental problem, and a more comprehensive consideration should thus be adopted. Based on the INRM of the dimensions, this study discovered that content (D_2) was affected by context (D_1) and social aspects (D_3), meaning that context (D_1) and social aspects (D_3) should be improved first.

The criterion with the greatest gap under context (D_1) is centralized training (C_{11}), and according to the INRM of context (D_1), the most influential criterion influencing centralized training (C_{11}) is job skills (C_{15}). That is, the most important task for continuous improvement of socialization is that new nurses acquire the necessary skills for clinical work. Edwards et al. (2015) proposed that the successful transition strategies create improvement in self-confidence and competency for new nurses who feel inadequately prepared can reduce their stress and anxiety. Welch and Carter (2018) described that deliberate practice and situated training experience can promote and contribute to new nurses

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with expected accomplishment in a clinical practice. O'Connor (2018) previously stressed that the importance of continued assessment, mentoring and coaching to improve and enhance professional competencies via systematic and standardized education program during the new nurses transition period. Similarly, the criterion with the greatest gap under social aspects (D_3) is duty fulfillment (C_{34}), and the INRM of social aspects (D_3) shows that the most influential criterion affecting duty fulfillment (C_{34}) is favorable interaction (C_{35}). Nielsen et al. (2016) also proposed that the issues of group interaction should be improved in order to retain new nurses. Hayes et al. (2006) emphasized human interaction and good working relationships as necessary for job retention and fostering a sense of belonging. Beecroft et al. (2008) also recognized that a new nurse should formulate a viable strategy to cope with the stresses of transition, which may include adjusting to a new job, mastering clinical skills, sharing experiences, becoming a team member and making new friends. This was an empirical case study specific to the subject hospital identified the key factors affecting the improvement of new nurse transition education programs. As such, it has limited generalizability to dissimilar situations. The characteristics of heterogeneity and timeliness must be considered.

Conclusion

The modified hybrid MCDM model was employed in this study to evaluate the organizational socialization of new nurses in one teaching hospital, after which feasible improvement strategies were explored. The major contributions of this study are as follows. First, a literature review was conducted on the organizational socialization of new nurses to determine and assess the main dimensions and criteria of performance in this sphere. Second, the influence relation matrix of DEMATEL was used to verify the relationship between the dimensions and criteria, after which these relationships were employed to construct an INRM. Third, the influential weights were acquired using DANP to improve upon the unreasonable independence assumptions of AHP, after which modified VIKOR was adopted to calculate the performance gap between each dimension and criterion by replacing the max–min approach with aspired level. Next, according to the INRM established using DEMATEL, the key factors affecting the sustainable improvement of new nurses' socialization were systematically derived, which helped avoid improvement suggestions that do not solve the fundamental problems. Finally, the validity of the research model and method in this study was verified using an actual case study. The results indicate a relatively great gap in the content dimension and that the solution to this gap should focus on the dimensions of context and social aspects.

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