Effect of an Ambidexterity Training Program on Innovative Behavior and Leadership Competencies Among Nurse Managers

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Abstract

Background: Ambidexterity is an emerging concept in nursing management that holds promise for achieving remarkable outcomes. To encourage ambidextrous behaviors among nurse managers, it is crucial to implement an ambidexterity training program. **Aim:** This study aimed to investigate the effect of an ambidexterity training program on the innovative behavior and leadership competencies among nurse managers. **Subjects and Methods:** This study employed a pre-experimental, single-group pre- and post-test research design that involved all 47 nurse managers from three hospitals in Port Said, Egypt: Port Said General Hospital, El-Zohuor Hospital, and Port Fouad General Hospital. Participants received a program of a four 120-min training sessions delivered over a 2-day workshop. The Ambidexterity Knowledge Questionnaire, the Ambidexterity Behavior Scale, Innovative Behavior Inventory, and the Penn State Leadership Competency Inventory were administered at three time points: pre-training, two weeks post-training, and 3-month follow-up. Single-factor repeated measures ANOVA was used to compare outcomes across the three time points. **Results:** Compared to pre-training scores, participants who underwent the ambidexterity training demonstrated significant improvement in their ambidexterity knowledge (F = 116.14, p < 0.001), ambidexterity behaviors (F = 12.74, p < 0.001), innovative behavior (F = 29.69, p < 0.001), and leadership competencies (F = 21.88, p < 0.001) at both post-training and 3-month follow-up assessments. While participants maintained the improvement at the 3-month follow-up assessment compared to pre-training, the degree of improvement was lower than that observed post-training. **Conclusion**: The ambidexterity training program was effective in increasing nurse managers' ambidexterity behavior, innovative behavior, and leadership competencies. **Recommendations:** Hospital administrators should consider incorporating ambidexterity training as part of the professional development programs offered to nurse managers.

Keywords: Ambidexterity training, Innovative behavior, Leadership competencies, Nurse manager

Introduction

Healthcare organizations are currently undergoing a period of significant transformation due to unforeseen advancements in technology and changing societal demands **(Al-Hussami et al., 2017).** As a result, it is imperative for healthcare leaders, especially nurse managers, to strike a balance between pursuing new ideas and improving existing services to ensure that high-quality care is delivered **(Caniëls & Veld, 2016).** This balance can be achieved through the concept of ambidexterity **(Mom et al., 2009),** which involves exploiting existing competencies while also exploring new opportunities and coordinating them in a flexible manner **(Havermans et al., 2015).**

Ambidexterity is defined as the ability to invest in already existing services while also looking towards the future for new services **(Malik et al., 2017).** In the nursing context, **Hannah et al. (2015)** define ambidexterity as the ability to simultaneously manage existing patient care processes (production-oriented) while also seeking new care processes for the future (development-oriented). Ambidexterity is a concept that involves balancing two strategies: exploration and exploitation. Exploration refers to seeking out new opportunities and experimenting with new ideas, while exploitation involves refining and optimizing existing processes and services to maximize efficiency **(Mom et al., 2009).**

The ambidexterity behaviors of nurse managers are essential to any healthcare organization, enabling them to effectively manage patient care in the present and adapt to future changes **(Yu et al., 2018).** Ambidextrous nurse managers also play a critical role in encouraging staff to discover new ideas and take risks through their openness and in refining and implementing those ideas through their closing behaviors towards staff **(Alghamdi, 2018).** Moreover, ambidexterity is beneficial in creating successful change **(Tushman, 2015)**. Additionally, ambidextrous nurses are more likely to engage in proactive behaviors, such as seeking out new information and taking initiative to improve patient care **(Caniëls et al., 2017).** Furthermore, ambidexterity in healthcare can create the right conditions to host and sustain innovation **(Ramdorai & Herstatt, 2015).**

In recent years, the concept of innovation has garnered significant attention from healthcare scholars and practitioners **(Asurakkody & Shin, 2018).** In healthcare, innovation refers to the process of implementing new and improved ideas to achieve better health promotion, disease prevention, and patient care **(Sönmez et al., 2019).** Similarly, in nursing, innovation is defined as the development of new nursing practices to replace traditional ones or the improvement of existing practices **(Huang et al., 2018). Lukes and Stephan (2017)** identified seven dimensions of innovation: idea generation, idea search, idea communication, implementation starting activities, involving

others, overcoming obstacles, and innovation outputs. By focusing on these dimensions, healthcare organizations can effectively implement innovation to improve patient outcomes and enhance healthcare delivery.

Healthcare organizations recognize innovation as an essential approach to enhance their effectiveness and competitiveness, as it is linked to improved job productivity, lower levels of job burnout, increased job satisfaction, solving organizational problems, organizational commitment, efficiency, and effectiveness **(Asurakkody & Shin, 2018).** Moreover, innovative behaviors exhibited by nursing mangers can help healthcare organizations improve patient experiences, promote community health, control costs, and overcome challenges **(Noles et al., 2019).** Additionally, nurse managers with high levels of innovative behavior possess the ability to engage in activities such as exploring new opportunities, identifying performance gaps, and developing solutions for organizational problems **(McLean, 2005).**

Nurse managers are responsible for ensuring the delivery of safe and high-quality care around the clock. They are also accountable for managing resources and operations, as well as ensuring compliance with legal and regulatory requirements **(American Nurses Association, 2016).** To achieve these responsibilities effectively, acquiring leadership competencies is essential **(Al-Hussami et al., 2017).** Leadership competencies refer to the set of attributes and skills that a nurse manager requires to excel in the nursing field **(Heinen et al., 2019)**. These competencies encompass various attributes, such as providing direction and support, motivating staff, coordinating activities, fostering collaboration, effective communication with the healthcare team, and making clinical decisions aimed at achieving quality patient care outcomes **(Alviniu, 2017)**.

According to **Yoon et al. (2010),** scholars at Penn State University have categorized the essential competencies for nurse managers into four dimensions: supervisory and managerial competencies, organizational leadership, personal mastery, and resource leadership. Given

that robust leadership competencies are linked to effective utilization of evidence in practice **(Gifford et al., 2018),** improved patient outcomes including patient safety and satisfaction with care **(Wong, 2015),** and enhanced financial performance of healthcare organizations **(Brewer et al., 2016),** it is crucial for nurse managers to possess such competencies.

Significance of the Study

Nurse managers play a critical role in healthcare settings, with responsibilities that include ensuring high-quality patient care, managing resources, and supervising staff **(Kuraoka, 2018).** With the ever-evolving landscape of healthcare technology, nurse managers must also exhibit a forward-thinking approach towards seeking new services while improving existing services to ensure continuity of care **(Foglia et al., 2019).** To accomplish these goals, nurse managers can exhibit ambidexterity behavior by combining the exploitation of existing services with the exploration of new opportunities, without compromising patient safety **(Malik et al., 2017).** As the implementation of ambidexterity in healthcare organizations is the responsibility of management **(Hoholm et al., 2018),** it is crucial to develop training programs that help nurse managers acquire the necessary ambidexterity skills **(Carmeli & Halevi, 2009).**

By exhibiting ambidexterity behaviors, nurse managers can yield profound outcomes for nurse managers, including adapting to new technologies and digital healthcare system **(Gastaldi et al., 2018)** and improving existing services, knowledge, and hospital programs **(Tuan, 2016).** However, there is limited research on how nurse managers can create ambidexterity in their workplace **(Koster & Van Bree, 2018).** To address this gap, this study aimed to develop and implement an ambidexterity training program that would increase nurse managers' awareness and skills in this area. Furthermore, ambidexterity is a relatively new concept in nursing management, and few studies have investigated its consequences **(Woods, 2016).** Thus, this study also aimed to address this shortcoming by investigating the effects of an

ambidexterity training program on the innovative behavior and leadership competencies of nurse managers.

The aim of the study:

This study aimed to investigate the effects of an ambidexterity training program on the innovative behavior and leadership competencies among nurse managers.

The study hypotheses:

H1: Nurse managers who undergo an ambidexterity training program will show an improvement in their ambidexterity knowledge when compared with their pre-training scores.

H2: Nurse managers who undergo an ambidexterity training program will show an improvement in their ambidexterity behavior when compared with their pre-training scores.

H3: Nurse managers who undergo an ambidexterity training program will demonstrate an improvement in their innovative behavior when compared with their pre-training scores.

H4: Nurse managers who undergo an ambidexterity training program will display an improvement in their leadership competencies when compared with their pre-training scores.

Subjects and Methods

Study design

A pre-experimental research design with a single-group pre-and post-test was used for the current study. In this type of design, data collection is carried out before and after the intervention with only the intervention group of participants, without randomization (LoBiondo-Wood et al., 2018). By applying in this study, only one group (i.e., intervention group) was present, and randomization was not possible as the study included all nurse managers in the participating hospitals.

Study setting

This study was conducted at three hospitals in Port Said Governorate, Egypt: Port Said General Hospital, El-Zohuor Hospital, and Port Fouad General Hospital. All of these hospitals are affiliated with the Ministry of Health and provide a wide range of healthcare services.

Study participants

The study participants included all nurse managers working in the study setting, defined as any nurses holding a managerial role such as nursing directors, deputy nursing directors, head nurses, unit charge nurses, and hospital committee nursing coordinators. To be eligible for participation, nursing managers were required to have held their current managerial position for at least 6 months. Nurse managers who are not willing to participate or were on leave due to sickness or maternity leave were excluded. Since all eligible nurse managers were invited to participate, no sampling method was used. A total of 67 nursing managers were invited to participate, with 31 from Port Said General Hospital, 18 from El-Zohuor Hospital, and 18 from Port Fouad General Hospital. Of these, 47 completed the intervention, as shown in Figure 1.

Figure. 1. Flow chart of the participants.
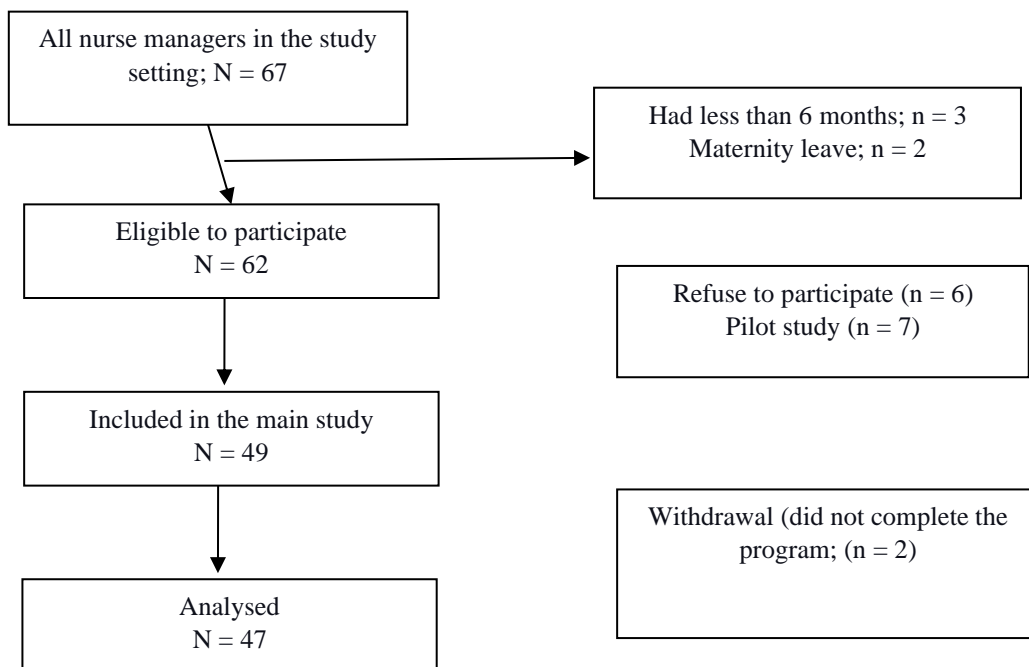
Ambidexterity training program

The ambidexterity training program was designed by the researchers in accordance with existing ambidexterity literature (**Jens, 2015; Junni et al., 2013; Kraner, 2018; Mom et al., 2009; Potoroczyn, 2013; Sun et al., 2017; Turner et al., 2013**) and underwent review and approval by an expert panel. The program consisted of four sessions delivered over a period of two days. Each session lasting approximately 120 minutes and a 30-minute break taken between sessions. The ambidexterity training was implemented three times, once at each study hospital.

The ambidexterity training program utilized various teaching techniques, including lectures, modified lectures, role-play, group discussions and Case studies, and was accompanied by educational materials such as handouts, presentations, posters, and pamphlets. Following the completion of the training sessions, all participants received an educational handout, and nurse managers were thanked for their participation and invited to share their feedback on the

program. The overview of the ambidexterity training
is shown in Table 1.

Table 1: Overview of the ambidexterity training

Session	Agenda	Content
Session 1	Ice breaking. Introduction to the program and inspire participants to participate. Background of ambidexterity.	• Self- introductions to get to know each other • Share the training rules • Identify the program aim • Benefits of ambidexterity training for nurse mangers • Outline the program content • Different concept related to ambidexterity • Importance of ambidexterity • Dimensions of ambidexterity • Question/answering and sharing
Session 2	Getting attention Continue teaching ambidexterity Background of ambidextrous leadership	• Warm-up • Review of the previous session • Comparison of exploration and exploitation • Forms of ambidexterity • Ambidexterity communication • Characteristics of ambidextrous leaders • Leadership principles that enable ambidexterity • Assign homework: write work situations you faced; ambidexterity would be beneficial to applicate • Question/answering and overview of the day
Session 3	Getting attention Provide nurse mangers with knowledge enable them to create ambidextrous workplace	• Warm-up • Review homework; share work situation nurses write and discuss them with the group • Review of the previous day • Mechanism for achieving ambidexterity • A multi-level categorization of ambidexterity mechanisms • How to build work environment that promote ambidexterity • Roles of nurse managers in building ambidextrous workplace • Question/answering and sharing
Session 4	1- Enhancing nurse managers understanding and application of ambidexterity	• Warm-up • Case study • Group discussion about their potential activities they can perform to implement ambidexterity • Question/answering and overview of all previous sessions.

Data collection tools

The data collection tools utilized in this study included a personal information form, the Ambidexterity Knowledge Questionnaire, the Ambidexterity Behavior Scale, Innovative Behavior Inventory, and the Penn State Leadership Competency Inventory. With the exception of the personal information form and the Ambidexterity Knowledge Questionnaire, the tools were originally developed in English. To account for language differences, a forward-backward translation procedure **(Brislin, 1970)** was utilized to create Arabic versions of the tools. First, a certified bilingual translator independently translated the English tools into Arabic to form the initial Arabic versions. Second, the first researcher re-translated the initial Arabic versions into English and compared them with the original tools to ensure semantic equivalence. Then, the version created from the forward-backward translation were piloted and subject to validity and reliability testing before conducting the main study. The study tools were administered at the pre-, post-, and follow-up data collection points.

Personal information form

The personal information form used in the study consisted of nine items. The items collected information on the participants' hospital of employment, age, gender, marital status, highest nursing degree obtained, current position, nursing experience, managerial experience in the current position, and whether they had previously attended any educational programs related to ambidexterity.

The Ambidexterity Knowledge Questionnaire

A total of 20 multiple-choice questions were developed by the researchers based on previous literature **(Jens, 2015; Junni et al., 2013; Kraner, 2018; Mom et al., 2009; Potoroczyn, 2013; Sun et al., 2017; Turner et al., 2013),** and research team group discussion to assess the level of knowledge that nurse managers had regarding ambidextrous behavior. The questionnaire covered seven dimensions: concept of ambidexterity (2 questions),

ambidexterity dimensions (3 questions), forms of ambidexterity (4 questions), ambidextrous communication (3 questions), characteristics of ambidextrous leaders (2 questions), mechanisms for achieving ambidexterity (3 questions), and roles of nurse managers in building an ambidextrous workplace (3 questions). Each question had four alternative choices, and only one choice was correct. Correct answers were scored 1 point, while incorrect answers were scored 0, resulting in a score range of 0 to 20. A higher score indicated a higher level of knowledge about ambidextrous behavior.

Ambidexterity Behavior Scale

The Ambidexterity Behavior Scale developed by Mom et al. (2009) was used to assess nurse managers' ambidexterity behaviors. The scale consists of 14 items, categorized into two dimensions; exploration activities (7 items), and exploitation activities (7 items). An example of an item is "Activities requiring you to learn new skills or knowledge." Participants rate the extent to which they engage in these work-related activities during their recent shift in the past two weeks, using a 7-point Likert scale ranging from "a very small extent = 1" to "a very large extent = 7." The average score of each dimension was calculated, and the sum of the average scores in the two dimensions was combined to form the total ambidexterity behavior score. Higher scores indicate a higher level of ambidexterity behavior among nurse managers.

Innovative Behavior Inventory

The Innovative Behavior Inventory developed by **Lukes and Stephan (2017)** was used to measure the level of innovative behavior among nurse managers. The scale comprises 23 items that are grouped into seven dimensions, including idea generation (3 items), idea search (3 items), idea communication (4 items), implementation starting activities (3 items), involving others (3 items), overcoming obstacles (4 items), and innovation outputs (3 items). An example of an item is "When something does not function well at work, I try to find new solution." The scale was compiled to a 5-point Likert scale ranging from "fully disagree = 1" to "fully agree

= 5." The total scale composite score was calculated using the average scores of the seven dimensions, with a higher summed score indicating more innovative behavior among nursing managers.

Penn State Leadership Competency Inventory

The Penn State Leadership Competency Inventory developed by Yoon et al. (2010), was used to assess the leadership competencies of nurse managers. The inventory consists of 32 items, grouped into four dimensions, including supervisory and managerial competencies (11 items), organizational leadership (10 items), personal mastery, (7 items), and resource leadership (4 items). An example of an item is "I have the abilities to identify, organize, plan and allocate resources." Participants respond to each item on a 5-point Likert scale ranging from "never = 1" to "always = 5." The average score of each dimension was computed by summing the items associated with it and dividing it by the number of items in the dimension. The overall Penn State Leadership Competency composite score was calculated by averaging the four dimensions scores. A higher score on the scale indicates a higher level of leadership competencies among nurse managers.

Validity and reliability/Rigor

The content validity of the study program and data collection tools was assessed prior to the commencement of the study by calculating the content validity index (CVI). A total of seven experts participated in the validation process, which included five academics in the nursing field and two nursing managers with at least a master's degree. The experts evaluated the clarity and relevance of the study materials and provided suggestions to improve their quality. The average CVI of the scales-items of all the measures used ranged from 0.97 to 1, indicating high content validity. The CVI for the study program was 0.95, indicating satisfactory content validity.

The reliability of the tools used in the study was assessed using Cronbach's alpha, which should be greater than 0.7 to be considered acceptable (**Hair et al., 2019).** In this study, the Cronbach's alpha was satisfactory across all three time points for all study scales: the Ambidexterity Behaviors Scale (pre-training = 0.91, post-training = 0.88, and follow-up = 0.90), the Innovative Behavior Inventory (pre-training = 0.93, post-training = 0.94, and follow-up = 0.91), and the Penn State Leadership Competency Inventory (pre-training = 0.87, post-training = 0.90, and follow-up = 0.91).

Field-work

The study was conducted between November 2018 and July 2019, lasting eight months. Data were collected at three different time points: (1) pre-training, (2) post-training (which occurred two weeks after the training program ended), and (3) follow-up (which occurred three months after the training program ended). Official permission was obtained from the hospitals where the study was conducted, and the first researcher met with the nursing director of each hospital to explain the study and obtain their assistance in recruiting participants. Each potential participant was provided with adequate information about the study and assured of confidentiality and anonymity. Those who agreed to participate signed a written consent and completed a pre-training test, which helped the researcher develop the training program.

After designing the program, the first researcher arranged a meeting with the nursing director and nursing training coordinator in each hospital to plan the training schedule and location. The training program was conducted in a private room in each hospital by the first researcher. Two weeks after the program was completed, post-training data collection was carried out. Three months after the program ended, follow-up data collection was carried out.

Pilot study

A pilot study was conducted to assess the clarity, simplicity, appropriateness, and relevance of the study tools and intervention program among a sample of 7 nurse managers (10% of the total target population) who were not participating in the main study. The cognitive interviewing method (Nichols & Hunter Childs,

2009) was used to evaluate their understanding and responses, particularly regarding the intervention program and the examples included in it. Additionally, participants were asked if any information needed to be added to the intervention program. The participants confirmed the completeness, appropriateness, and clarity of the study tools and intervention program, and no amendments were deemed necessary based on their feedback.

Ethical consideration

The study was conducted in compliance with the Declaration of Helsinki, ensuring that each participant received adequate background information on the study, including its objectives, timeline, and potential benefits, prior to participation. Anonymity and voluntary participation were guaranteed, and informed consent was obtained from all participants. Participants were also informed of their right to withdraw from the study at any time without penalty. Finally, it was confirmed that the data collected would be used solely for the purposes of the study.

Data analysis

The study employed version 22.0 of the Statistical Package for Social Sciences (SPSS) for data analysis. Normal distribution of the data was assessed using the Shapiro–Wilk test. Demographic characteristics were evaluated using counts and percentages for categorical variables, and mean and range for continuous variables. Single-factor (time) repeated measures analysis of variance (ANOVA) was used to evaluate the changes in pre-training, post-training, and follow-up training scores for the study outcomes (i.e., ambidexterity knowledge, ambidexterity behavior, innovative behavior, and leadership competencies) with Greenhouse–Geisser correction. In cases where the repeated measures ANOVA yielded significant changes, pairwise comparisons using Bonferroni correction were performed for post-hoc tests. The effect size was determined using the partial eta-squared (η_p^2) and classified as having small (0.01–0.06), medium (0.06–0.14), or large (≥ 0.14) effects (Richardson, 2011) criteria. The study adopted a significance level of .05 (two-tailed).

Results

Table 2. Demographic characteristics (N = 47).

Characteristic	Category	no	Percent	Mean (SD)	Range
Hospital	Port Said general hospital	22	46.8		
	El-Zohuor hospital	14	29.8		
	Port Fouad general hospital	11	23.4		
Age (years)	≤35	17	36.2	35.57 (7.09)	24-53
	>35	30	63.8		
Marital status	Single	5	10.6		
	Married	35	74.5		
	Divorced	3	6.4		
	Widowed	4	8.5		
Nursing degree	Diploma	34	72.3		
	Associate	6	12.8		
	Bachelor	5	10.6		
	Master	2	4.3		
Present position	Nursing director	3	6.4		
	Deputy directors	2	4.3		
	Head nurse	19	40.4		
	Charge nurse	15	31.9		
	Committee coordinator	8	17.0		
Experience in nursing (year)	≤10	9	19.1	21.90 (7.91)	2-34
	>10	38	80.9		
Experience in current position (year)	≤5	19	40.4	7.32 (4.57)	1-18
	>5	28	59.6		

SD, standard deviation. Note: all participants were female and reported no prior educational program on ambidexterity

All of the study participants were female, with a mean age of 35.57 years (SD = 7.09). Among the participants, 74.5% were married, and 72.3% had a diploma degree. In terms of employment profile, the majority of the participants were working at Port Said General Hospital (46.8%) and held a head nurse position (40.4%). Most of the participants had over ten years of nursing experience (80.9%) and had been in their current managerial position for five years or less (40.4%). None of the participants had previously attained training program related to ambidexterity (Table 2).

Table 3: Changes in the mean score of participants ambidexterity knowledge and behavior over time (N = 47).

Variable	Pre	post	3 months Follow-up	F (p)	Pairwise comparison (p)		η_p^2
	Mean (SD)	Mean (SD)	Mean (SD)		Pre-post	Pre-follow	
Ambidexterity Knowledge	7.40 (1.56)	12.47 (1.60)	8.43 (1.34)	116.14 (<0.001)	<0.001	0.028	0.72
Exploration	25.76 (7.60)	30.28 (8.37)	29.93 (8.33)	8.72 (0.005)	0.01	0.02	0.16
Exploitation	27.02 (5.77)	31.42 (5.48)	30.74 (5.01)	18.42 (<0.001)	<0.001	<0.001	0.29
Total Ambidexterity behavior	52.78 (12.91)	61.70 (13.00)	60.17 (12.81)	12.74 (<0.001)	<0.001	0.008	0.22

F= one factor (time) repeated measure ANOVA

Table 3 presents the changes in mean scores of participants' ambidexterity knowledge and behavior across different time points. Results from the single-factor repeated measures ANOVA revealed a significant time effect of participants' knowledge regarding ambidexterity (F = 116.14, p < 0.001), indicating a statistically significant improvement in participants' knowledge related to ambidexterity after receiving the training program at different stages of the study, with a large effect size ($\eta_p^2 = 0.72$). The Bonferroni pairwise comparisons showed a significant increase in participants knowledge immediately after training completion (M (SD) = 12.47 (1.60)) compared with pre-training (M (SD) 7.40 (1.56)) with p value < 0,001, and this improvement was maintained after three months of program conduction (M (SD) = 8.43 (1.34)) with p value = 0.028. The results showed also a decline in the participants knowledge mean score from post to follow up stage with a mean difference of 4.04 points.

Regarding the variable "ambidexterity behavior," results from Table 3 demonstrated that differences in the scores of ambidexterity behavior at different stages of the study were statistically significant (F = 12.74, p < 0.001), with a large effect size ($\eta_p^2 = 0.22$). Mean scores improved significantly from pre-training (M (SD) = 52.78 (12.91)) to post-training (M (SD) = 61.70 (13.00)), with a p-value < 0.001, and this improvement was sustained three months following training (M (SD) = 60.17 (12.81)), with a p-value = 0.008. However, there was a slight drop in the ambidexterity behavior mean score from post-training to follow-up stage, with a mean difference of 1.53 points. Furthermore, the results showed that the ambidexterity training program led to a significant increase in both participants' exploration (F = 8.72, p = 0.005) and exploitation behaviors (F = 18.42, p < 0.001), with a large effect size ($\eta_p^2 = 0.16$, and 0.29, respectively).

Table 4: Changes in the mean score of participants innovative behavior over time (N = 47).

Variable	Pre	post	3 months Follow-up	F (p)	Pairwise comparison (p)		η_p^2
	Mean (SD)	Mean (SD)	Mean (SD)		Pre-post	Pre-follow	
Idea generation	5.06 (1.65)	6.72 (1.58)	6.46 (1.50)	22.78 (<0.001)	<0.001	<0.001	0.33
Idea search	5.12 (1.83)	8.19 (2.08)	5.34 (1.76)	57.46 (<0.001)	<0.001	0.06	0.56
Idea communication	6.34 (2.09)	9.32 (2.15)	8.32 (1.59)	38.72 (<0.001)	<0.001	<0.001	0.46
Implementation starting activities	5.38 (1.96)	6.98 (1.52)	6.46 (1.43)	16.29 (<0.001)	<0.001	0.004	0.26
Involving others	5.21 (1.98)	6.06 (2.05)	7.81 (1.53)	44.87 (<0.001)	<0.001	<0.001	0.49
Overcoming obstacles	8.51 (2.49)	8.66 (2.7)	8.4 3(2.45)	0.14 (0.87)	0.945	0.992	0.003
Innovation outputs	6.34 (1.35)	8.04 (1.83)	7.17 (1.56)	25.83 (<0.001)	(<0.001)	0.011	0.36
Total innovative behavior	41.96 (9.78)	53.98 (11.37)	50.00 (9.04)	29.69 (<0.001)	(<0.001)	(<0.001)	0.39

F= one factor (time) repeated measure ANOVA

Table 4 illustrates a significant change in participant innovative behavior across time (F= 29.69; p < 0.001), indicating that the ambidexterity training program was effective in enhancing participant innovation throughout the study phases with a large effect size (η_p^2 = 0.39). The mean scores of participants' innovative behaviors improved from pre-training (M (SD) = 41.96 (9.78)) to post-training (M (SD) = 53.98 (11.37)), and this improvement was significant (p < 0.001). This improvement was maintained three months following training (M (SD) = 50.00 (9.04)) with a p-value of <0.001. However, the participants' mean scores in the follow-up stage decreased by 3.98 points compared to the post-training stage. Among the innovation behavior dimensions, the "overcoming obstacles" dimension showed no significant difference across the study's three phases (F= 0,14; p = 0,87; η_p^2 = 0.003).

Table 5: Changes in the mean score of participants leadership competencies over time (N = 47).

Variable	Pre	post	3 months Follow-up	F (p)	Pairwise comparison (p)		η_p^2
	Mean (SD)	Mean (SD)	Mean (SD)		Pre-post	Pre-follow	
Supervisory and managerial competencies	20.02 (7.27)	28.53 (8.05)	26.85 (7.16)	24.59 (<0.001)	<0.001	<0.001	0.35
Organizational leadership	21.51 (5.77)	26.11 (5.71)	24.91 (4.87)	13.27 (<0.001)	<0.001	0.008	0.22
Personal mastery	16.40 (4.10)	20.38 (3.60)	19.32 (4.04)	16.64 (<0.001)	<0.001	0.007	0.27
Resource leadership	7.26 (2.43)	12.19 (3.39)	10.53 (3.02)	52.11 (<0.001)	<0.001	<0.001	0.53
Total leadership competency	65.19 (18.97)	86.15 (20.72)	81.62 (18.59)	21.88 (<0.001)	(<0.001)	(<0.001)	0.32

F= one factor (time) repeated measure ANOVA

According to Table 5, there was a significant effect over time on participants leadership competences (F= 21.88; p < 0,001), indicating the ambidexterity training program was significantly

effective in enhancing participant leadership competences across the study phases with a with a large effect size ($\eta_p^2 = 0.32$). The mean score of participants leadership competences post-training (M (SD) = 86.15 (20.72)) showed an improvement than that of pre-training (M (SD) = 65.19 (18.97)) and this improvement was significant (p < 0,001). Additionally, the mean score of participants leadership competences in follow up (M (SD) = 81.62 (18.59)) is higher than that of pre-training and this improvement was significant (p < 0,001). However, the participants mean scores in follow up stage decreased by 4.53 points than post training stage. All of the leadership competences dimensions (supervisory and managerial competencies, organizational leadership, personal mastery, and resource leadership) showed a significant difference across the study three phases with large effect size ($\eta_p^2 = 0.35, 0.22, 0.0.27,$ and 0,53; respectively).

Discussion

Learning ambidexterity is crucial for improving job performance and promoting organizational development (**Wei et al., 2014).** In this context, the current study aimed to investigate the effect of an ambidexterity training program on the innovative behavior and leadership competencies among nurse managers. The findings demonstrated that the training program resulted in long-term enhancement of ambidexterity knowledge among nurse managers. However, a slight mean decline was observed during the follow-up evaluation compared to post-training evaluation. This decline could be attributed to a decrease in data and information by passing time, highlighting the need for periodic refreshing and updating of knowledge. These findings are consistent with **Ma et al., (2018)** who reported the effectiveness of training programs in transferring knowledge among healthcare workers. Similarly, **Sender (2015)** conducted an ambidexterity training program among Romanic students and found that it improved their ambidexterity knowledge.

The study findings also revealed a significant improvement in ambidexterity behaviors among nurse managers, as evidenced by the higher mean scores in the post and follow-up evaluations compared to the pre-intervention mean scores. The effectiveness of the program in enhancing ambidexterity behaviors may be attributed to several factors, including the voluntary participation of the nurse managers, which may have increased their feeling of freedom to learn. The researchers also emphasized the importance and benefits of the program during the first session, which may have increased their curiosity to learn and engagement in the program. Additionally, the training program utilized various learning methods, such as case studies and participants' past experience situations, which may have enhanced the participants' understanding of the training content.

These results are consistent with **Junni et al. (2015)** who asserted that ambidexterity can be enhanced by training. Furthermore, **Lavikka et al. (2015)** demonstrated that ambidexterity interventions are the strategy that should be used to build ambidexterity within organizations. Additionally, **Malik et al. (2017)** emphasize the role of training in creating and sustaining an ambidextrous context for healthcare professionals. Noteworthy, while the follow-up evaluation scores were higher than the pre-training scores, there was a slight decline in the mean scores during the follow-up evaluation when compared to the post-program scores. This indicates the need for periodic training to sustain and reinforce the improvement in ambidexterity behaviors among nurse managers.

Concerning innovation behaviors, the study results demonstrated that the innovative behaviors of nurse managers significantly improved in the post-intervention and follow-up phases compared to the pre-intervention phase. This improvement may be attributed to the ambidexterity training that encouraged nurses to explore new ideas and think outside the box, leading to enhanced innovative work behavior among nurse managers. This finding is in agreement with a cross-sectional study conducted among Washington chief nursing officers, which found that ambidextrous leadership behaviors accounted for a statistically significant portion of the variance in innovative performance (**Wasilewski, 2019).** Moreover, a study by **Malik et al. (2017)** reported that the

ambidexterity behaviors of healthcare managers played an essential role in fostering innovation. Similarity, **Rosing and Zacher (2016)** found a positive relationship between individual ambidexterity and innovative performance.

Regarding leadership competencies, the results indicated a significant improvement in the leadership competencies of nurse managers during the post-intervention and follow-up phases, compared to the pre-intervention phase. This improvement could be attributed to the fact that ambidexterity training enhances adaptability, flexibility, and resilience, which ultimately enhances the leadership competencies of nurse managers. These findings are consistent with previous research, as **Mom et al. (2015)** found that managerial performance is linked to a manager's ambidexterity, and **Simsek et al. (2009)** argued that a manager's competencies result from their ability to be ambidextrous. Moreover**, Volery et al. (2013)** found that leaders who exhibit ambidexterity also have high levels of managerial competencies.

Conclusion

In conclusion, this pre-experimental, single-group pre-and post-test study provides evidence that a four-session ambidexterity training program conducted over two days was effective in enhancing the ambidexterity knowledge, ambidexterity behavior, innovative behavior, and leadership competencies of nurse managers. The results showed a large effect size for all study variables during the post-training and follow-up evaluations. Although the follow-up evaluation scores in all study variables were higher than the pre-training scores, there was a slight decline in the mean scores during the follow-up evaluation when compared to the post-program scores.

Recommendations:

The following recommendations are made based on the findings of this study:

❖ The concept of ambidexterity should be introduced in both undergraduate and postgraduate healthcare education.

❖ Healthcare policy makers should incorporate ambidexterity training as part of their professional development programs for nurse managers at all levels and offer it periodically.

❖ Healthcare policy makers should foster a culture of ambidexterity and prioritize its inclusion in strategic planning of the healthcare organization.

❖ Hospital administrators should specify a clear policy and regulation fostering ambidexterity behaviors in the healthcare stings.

❖ Healthcare administrators should consider implementing clear policies and regulations that encourage ambidexterity behaviors in healthcare settings.

❖ Hospital administrators should proactively support and encourage the innovative behaviors of nurse managers by rewarding such behavior and providing them with the necessary time and resources to carry out their innovative efforts.

❖ Nurse managers should must possess a diverse range of competencies related to research, political and legal issues, finance, and quality management.

❖ Future research is needed to increase the level of evidence supporting the efficacy of ambidexterity training programs for nurse managers. These studies could include control groups and larger sample sizes. Additionally, investigations into the long-term effects of these workshops and their impact on other outcomes such as job engagement and knowledge sharing are needed.

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