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The Study of Learning Effectiveness for Nurse Post Graduate Year and Nursing Students After Electronic Simulator Teaching Program

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The Study of Learning Effectiveness for Nurse Post Graduate Year (NPGY) and Nursing Students after Electronic Simulator Teaching Program

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ABSTRACT
■Purpose of the Study
Electronic simulators can provide instructors with ways to simulate first aid situations, simulate breathing and circulatory systems, as well as providing skills training in different situations and improving clinical ability of clinicians and students. The present study aims at exploring the learning effects of using an Electronic Simulator Teaching Program in Nurse Post graduate Year and nursing students.
■Methods
This is a quasi-experimental research design with pre- and post-test. Participants are in their Nurse Post graduate Year, who have been employed for less than 1 year in the adult ward of a medical center in the central part of Taiwan (N=69), and nursing students at a university (N=66). Totally, 135 were involved. Before the research intervention, the pre-test was conducted with the "Cognitive Questionnaire for the Treatment of Dyspnea" and the "Skills Test for the Treatment of Dyspnea." Then, we used an electronic simulator to intervene in the dyspnea teaching, and the post-test was implemented two weeks after course completion. SPSS 20.0 was used to code and analyze care effectiveness data.
■Results
After Nurse Post graduate Year and nursing students received the intervention of electronic simulants, the results indicated the post-test is better than the pre-test, with significant results ($p<0.001$). After the intervention of the electronic simulant teaching, Nurse Post graduate Year's "skills" learning effectiveness in dealing with dyspnea is better than that of nursing students.
■Conclusion
The intervention of the electronic simulator can significantly improve the learning effectiveness of NPGY and nursing students. Thus, the findings can serve as a reference for the development of future nurse training programs.
KEYWORDS– Simulation, Electronic simulator, Nursing teaching program, Nurse Post graduate Year (NPGY)

I. INTRODUCTION

With the rapid development of medicine and technology, the inpatients' acuteness has been increased. Nursing staff members must monitor the condition of patients 24 hours a day. When assessing a patient's response, nurses need to interpret the monitoring equipment and perform physical assessment, along with being clear about the operation skills and drug-related knowledge. At times, it is necessary to take into account a variety of therapeutic equipment and quickly complete needed treatments according to the patient's situation to adjust intervention measures whenever necessary. While dealing with a variety of error-prone invasive technologies, it seems necessary to maintain the patient's safety (Benner, Sutphen, Leonard, & Day, 2010). However, owing to the ever-changing clinical situation, nursing graduates who enter the clinic may face such conditions. They often feel what they have learned at school cannot meet the workplace needs.

When feeling frustrated, under various pressures and due to improper team communication or failure to identify a patient's condition, patient safety incidents occurred, making graduates fail to meet industry expectations. The rate of new nursing recruits' resignation is high. How to improve teaching strategies so as to improve nursing education for the medical industry is a matter of urgency. Nurse Post graduate Year (NPGY) core training is based on classroom teaching and online teaching, with one-on-one clinical teaching by clinical counsellors as a supplement; so, novice clinical nurses lack practical ability and experiences. In addition, with insufficient training in reasoning ability, such nurses cannot adapt to clinical life and decide to leave the nursing workplace (Lai et al., 2014). From the new nursing students' perspective, the study on the "effectiveness of the teaching expense subsidy program in teaching hospitals" pointed out that the self-assessment of new recruits in "bringing school education to clinical work" was 60%, and "improving clinical practice ability" was 60%. "The ability of team members, patients or family members to interact and communicate" reached 70%, showing that there exists room for improvement in the effectiveness of clinical work and clinical practice capabilities of new recruits (Zhang, Hong,

Gao, Lin, 2017). Therefore, only by changing the teaching mode can new recruits improve their practical ability and reduce the gap in learning.

In recent years, situational simulation education has been applied to medical education-related research, agreeing that situational simulation teaching is an effective learning strategy (Xu, 2014; Xiao, 2014). Using electronic simulators, the instructor can simulate breathing and circulatory systems according to the simulated first [s]aid scenarios designed to facilitate the training skills in different scenarios. Providing realistic clinical situation drills through electronic simulators allows students to learn nursing-related knowledge, technology, communication, and critical thinking repeatedly. Participating in nursing activities not only allows students to deepen their learning experience, but also enhances self-confidence. Via instructor's guidelines, students' feedback and reflection promotes communication and teamwork strengths. Further, by reviewing safety measures during care activities, negligence while performing clinical workings can be avoided (Hong et al., 2013; Zhou, Huang, Liu, 2014). Reviewing literature, there have been cases of electronic simulators in the medical community, with good results made in the situational awareness, clinical ability, teamwork and communication, critical thinking, self-confidence and anxiety reduction of the teaching objects.

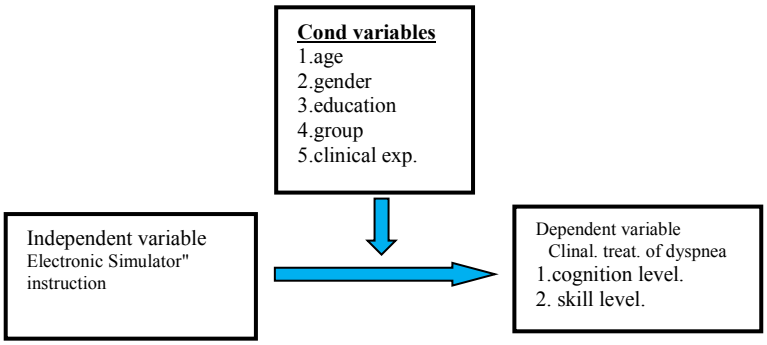
Currently, it is implemented in internship medical students or general medical training and first aid-related training after graduation. However, it is rarely used in clinical evaluation and treatment of symptomatic nursing. Still, little literature discussed the use of electronic simulators for new in-service nurses and graduates one year after graduation, and nursing students' learning effectiveness studies remain none. Therefore, the researchers expected that the "electronic simulator" can be used in the teaching of NPGY students and nursing students to improve the effectiveness of learning, integrate teaching and usage so as to reduce the gap between learning and use, and improve the clinical nursing and novice nursing students. Self-confidence can further be explored for the difference between the effectiveness of using "electronic simulators" between nursing students and newly recruited in-service nurses after graduation. The results of the research can provide reference for future nursing school teaching design and in-service education for new clinical nursing staffs.

II. METHOD

2.1 Research design and procedure

This is a single-group pre- and post-test design. It uses purposive sampling and "electronic simulator" teaching as an intervention measure. From October 2019 to November 2019, the adult ward of a medical center and the nursing department students of a science and technology university are targeted for sampling. Qualification is that a medical center in the central part serves adult wards, NPGY students under one year of service and senior nursing students with a nursing license. Before proceeding with data collection, this study was approved by the Human Trial Committee of a hospital in the central part of Taiwan. Based on the "informed consent" of the research ethics and the principle of autonomy, the researcher personally explained the research purpose to the research subjects. Then, they signed the "Consent to Participate in the Research".

This research framework is based on the "Electronic Simulator" teaching plan developed by researchers with reference to relevant domestic and foreign literatures. It aims to explore the impact of the "Electronic Simulator" teaching plan on the cognition and skills of clinical management of dyspnea. The research framework is as follows:



By purposive sampling, the researchers classified the students, who signed up for the "Electronic Simulator" teaching workshop, into NPGY students group (within 1 year of the medical center's adult ward into NPGY group), and the college students' group (sophomore students from nursing science and technology college). NPGY students are grouped according to the registration sequence, unit and subject, about 6-8 persons in a group. In order to avoid the loss of cases, a total of three workshops were organized in accordance with the convenient time of the research participants. The nursing students' group is organized to take part in two workshops by their registration sequence. To avoid the inferential factors that occurred in the results, the instructor in each workshop remains the same. The research procedure is as follows: 1. written materials and audio-visual independent teaching conducted one week before the instruction; 2. pre-test made; 3. "electronic simulator" teaching proceeded; 4. post-test made two weeks after the workshop.

2.2 Research tools' validity and reliability:

2.2-1 Design of "Electronic Simulator" Teaching Workshop

The intervention measures in this study are the "electronic simulator" teaching plan. The design of the teaching plan is based on interviews and observation of clinical nursing staff who take care of breathing difficult patients. The patient's experience, and reference to domestic and foreign relevant literature, the design process of the teaching plan is as follows: 1. Analyze learners' characteristics, 2. Set the learning goal based on the core competence, 3. Develop "Electronic Simulator" teaching guidelines for dyspnea, 4. Choose teaching resources, 5. Make teaching materials.

2.2-2 Cognitive Questionnaire on Clinical Management of Dyspnea

Research objects' demographic information includes age, gender, education level, clinical work subject and clinical qualifications in nursing. This measurement tool is contained with multiple documents, and is compiled according to the content of the teaching plan, with a total of 25 questions (each right answer is worth one point, the highest score is 25). The more points the better for the clinical evaluation and management of dyspnea (Chen et al., 2016; Chang, Munson, Gifford, & Mahler) , 2015; Fuessl, 2016). 5 experts, including nursing education scholars, thoracic physicians and senior nursing specialists in cardiology and thoracic specialty wards, etc., were invited to conduct expert validity verification for "content relevance" and got the CVI value of 0.96. After revising the questionnaire, a total of 10 nursing staff who did not participate in the teaching plan participated in the pre-test. As a result, the Kuri-21 coefficient (KR-21) was gained at .71, within the acceptable range of .6 to .7 (Qiu, 2012).

2.2-3 "Objective Structured Clinical Test (OSCE)" for clinical management of dyspnea

This scale, referred from previous literature(s), evaluates the nursing staff's ability to perform clinical assessment and treatment of dyspnea, with a total of 18 items. The scores are: "completely done" (3 points), "mostly done" (2 points), "partially done" (1 point), "not done" (0 points); this test has a total of 18 questions, the higher the score, the more accurate the treatment of dyspnea. 5 nursing education scholars, including thoracic physicians, and nursing specialists in cardiology and thoracic specialty wards were invited to evaluate content validity index (CVI) so as to conduct expert validity verification on "adequacy". The CVI value, ranging from 0.88 to 1.00, with an average value of 0.95, meets the CVI value at 0.8 or above. In order to achieve the consistency of the scorers, 6 nurses who did not participate in the teaching program and met the sampling conditions, were trained to score. Ultimately, with consistency-related reliability, Cohen's Kappa Coefficient was at 0.88, reliability was greater than 0.8 (Cohen, 1960; Landis & Koch, 1977).

2.3 Data analysis

The researchers collected and analysed data via SPSS 20.0 version of the statistical software package. The descriptive statistics were used: numbers, percentage, average, and standard deviation. The inferential statistic data was used: average, standard deviation, paired sample t-test, independent sample t-test, and generalized estimation equation (GEE) test for repeated measurement scores. We also analysed the clinical treatment of dyspnea after the "electronic simulator" intervention teaching program for "Cognition, and skills". Also, the difference between the pre- and post-tests, and the difference in learning effectiveness between the nursing students and the NPGY group were also evaluated.

III. RESULTS

3.1 Demographic information

135 students participated in the study. Their average age is 21.96 with a standard deviation of 1.44; 125 women, accounting for 92.59%, and 10 men, accounting for 7.41%. 88 of them are college juniors and seniors, accounting for 65.18%, followed by 29 university students, accounting for 21.48%, 9 from a technological institute, accounting for 6.67%, and 9 from junior college, accounting for 6.67%; 69 in the NPGY group, accounting for 51.11%; 66 in the nursing students group, accounting for 48.89%; 66 without clinical experience, accounting for 48.89%; 25 with internal medical experience, accounting for 18.52%; and 44 with surgical experience, accounting for 32.59 %. The average seniority with clinical experience is 4.24 months.

3.2 Effectiveness of "Electronic Simulator" teaching intervention

Cognitively, the average scores of NPGY's pre-test and post-test were 15.35 and 18.30 respectively. The post-test was better than the pre-test with statistically significant difference ($p<.001$). The average scores of nursing students' pre-test and post-test were 17.05 and 18.97 respectively, the post-test is better than the pre-test with statistically significant difference ($p<0.001$).In terms of skills, the average scores of NPGY, before and after the test were 22.61 and 47.42 respectively, the post[-]test was better than the pre-test with a statistically significant difference ($p<.001$), and the average scores of the pre[-]test and post-test of nursing students were 22.14 and 42.89 respectively, the post-test is better than the pre-test with a statistically significant difference ($p <.001$).

3. Differences in learning effectiveness between NPGY and nursing students

3.3-1 Effectiveness of cognitive learning differences

The pre-test score (17.05 ± 2.63) of the nursing students was higher than that of NPGY (15.35 ± 2.80), with a significant difference ($p<.001$); after simulating the dyspnea teaching program through high-fidelity situations, the post-test score of the

nursing students (18.97 ± 2.29) is higher than NPGY (18.30± 2.65), but no significant difference (p= .122) was found. Further comparing the difference between the NPGY pre- and post-test progress scores and the nursing students' pre- and post-test progress scores, p=.075, did not reach a significant difference. so it shows that there is no difference in cognitive learning effectiveness between the NPGY and the nursing students after the electronic stimulant teaching intervention.

3.3-2 Effectiveness of skill learning differences

The NPGY pre-test score (22.61 ± 1.05) is higher than the nursing students (22.14 ± 1.28), p=.020, with a significant difference; after the intervention of "Electronic Simulator Teaching", the NPGY post-test score (47.42 ± 1.18) is significantly higher than the nursing students (42.89 ± 1.42), p<.001, with a significant difference. To further compare the difference of pre- and post-test progress scores between the NPGY and the nursing students, the NPGY skill pre- and post-test progress scores were significantly higher than the nursing students, p<.001 reached a significant difference; this indicated that the simulating dyspnea teaching program intervention after the skill learning, the effectiveness of the NPGY group was better than that of the nursing student group.

Analysis of pre- and post-test for "Electronic Simulator" teaching plan (*N*= 135)

item	NPGY (*n*=69)		*p* A1	Nurse Students (*n*=66)		*p* A2	*p* B1	*p* B2	*p*B3
	pre-test	post-test		pre-test	post-test				
	Mean ± *SD*			*Mean* ± *SD*					
cognition	15.35 ± 2.80	18.30 ± 2.65	<0.001***	17.05 ± 2.63	18.97 ± 2.29	<0.001***	<0.001***	0.122	0.075
skill	22.61 ± 1.05	47.42 ± 1.18	<0.001***	22.14 ± 1.28	42.89 ± 1.42	<0.001***	0.020*	<0.001***	<0.001***

A1：NPGY pre- vs post-test (paired samples of t-test) A2：nurs. Students' pre- vs post-test(paired samples of t-test)
B1：NPGY pre- vs nursing stud. Pre-test(Inde. Sample t-test) B2：NPGYpost-test vsnurse stud post-test(ind.sample t-test)
B3：NPGY difference between pre and post test vs nurse stud. difference of pre and post test (indi sample t-test)
*p < .05 was considered statistically significant. (*p<0.05, **p<0.01, ***p<0.001).

Cognition, skill pre- and post-test GEE results analysis (*N* =135)

variables	Cognition GEE diff. compare				Skill GEE diff. compare			
	B	*SE*	X^2	*p*	*B*	*SE*	X^2	*p*
intercept items	15.348	0.335	2101.521	<0.001***	22.609	0.125	32694.393	<0.001***
N. students and NPGY pre-test diff compare	1.689	0.464	13.368	<0.001***	-0.472	0.200	5.589	0.018
NPGY pre- and post-test diff comparison	2.957	0.363	66.387	<0.001***	24.812	0.193	16601.144	<0.001***
N. students and NPGY pre- and post-test diff compare	-1.032	0.573	3.241	0.072	-4.054	0.301	181.863	<0.001***

Reference group:「NPGY x Pre-test」, Interaction means (Nurs students' post minus pre-test}-{NPGY post-test minus NPGY pre-test})*p<0.05, **p<0.01, ***p<0.001

IV. CONCLUSION AND DISCUSSION

The "cognition" and "skill" post-tests results of the NPGY and nursing student groups are better than the pre-test results, and are statistically significant. Therefore, the research results show that the "Electronic Simulator" intervention teaching program can effectively improve the cognition and skills of NPGY and nursing students, reaching statistically significant differences. The results are similar to those of Tamaki et al. (2019), Li Hegao (2016), and Vandyk et al. (2018). Barton, Bruce and Schreiber (2018) in the comprehensive review literature of nurturing team ability in nursing education proposed that

simulation teaching is the most effective way to cultivate skills and teamwork ability. Waxman, Bowler, Forneris, Kardong and Rizzolo (2019) suggested that simulated teaching could replace 50% of clinical time, improving skills, communication, and teamwork, even though simulated teaching is the most effective way to educate skills, self-efficacy and teamwork. However, although nursing instruction is no longer in traditional classrooms, some professional subjects will be combined with situation simulation in the curriculum. Because of the limited teachers, devices, and large class teaching, not every student has the opportunity to practically manipulate simulators. Compared with the traditional teaching mode, the simulation hardware and equipment are expensive to construct and maintain. Teaching preparation process is time-consuming and labor-intensive. Teachers need to have the teaching ability to use equipment and context design, and they need to be proficient in new teaching skills; therefore, their teaching load remains higher (Lu et al., 2018; Chen, 2013). Therefore, it is not widely

used in nursing education of different academic systems. The results indicate that the e-simulator teaching strategy can improve the cognitive and skill learning goals of nursing students and NPGY students. Helping students develop the professional qualities and abilities required for clinical practice is an indispensably important strategy for nursing education. Through the independent sample T-test, we compare the difference between the NPGY group and the nursing students' pre- and post-test progress scores. The two groups' "cognitive" pre- and post-test progress scores did not reach a significant difference; the "skill" NPGY's pre- and post-test progress scores were higher than the nursing students and reached a significant difference. Further, through GEE analysis, the gap between the nursing students and the NPGY test before and after the intervention of the "Electronic Simulator" teaching program was verified. The gap between the changes of the nursing students and the NPGY "cognition" before and after the test was still not up to a significant level. Nursing students' scores changes are less than those of NPGY's, and reach a statistically significant level. The reasons are that NPGY group has entered clinical practice and may have experienced clinical patients with actual breathing difficulties or have dealt with patients with breathing difficulties. Through the "Electronic Simulator" teaching program, their skills have improved better than those without actual experience of dyspnea as nursing students. From the research results, we inferred that if the background and time of the "electronic simulator" teaching intervention can be given after some clinical experience and/or students might have some background knowledge of such simulator, the learning effectiveness of skills, attitudes and teamwork can be more significant. So the results of this study can provide a reference for the curriculum design of nursing. The timing of the intervention should be arranged and established after the students have a basic internship in medical and surgical practice, acute and critical illness-related internships. The course can focus on the most difficult clinical situations that occur in clinical practice. When it is clinically integrated, enhancing its cognition, clinical skills and self-confidence in applying to NPGY on-the-job education design. It is recommended that the course can be added to the training course of 1 to 3 months for newcomers who enter the workplace. The same focus is on the clinically most difficult situation to deal with, and it can also improve its clinical ability, attitude and teamwork cooperation effectiveness. In the future, "Electronic Simulator" situation teaching can be designed for NPGY student training in response to different levels of clinical difficulties. In order to improve the learning effectiveness of clinical nursing staff, the above research results can show the importance of future school teaching and hospital arrangements for NPGY on-the-job education as reference.

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