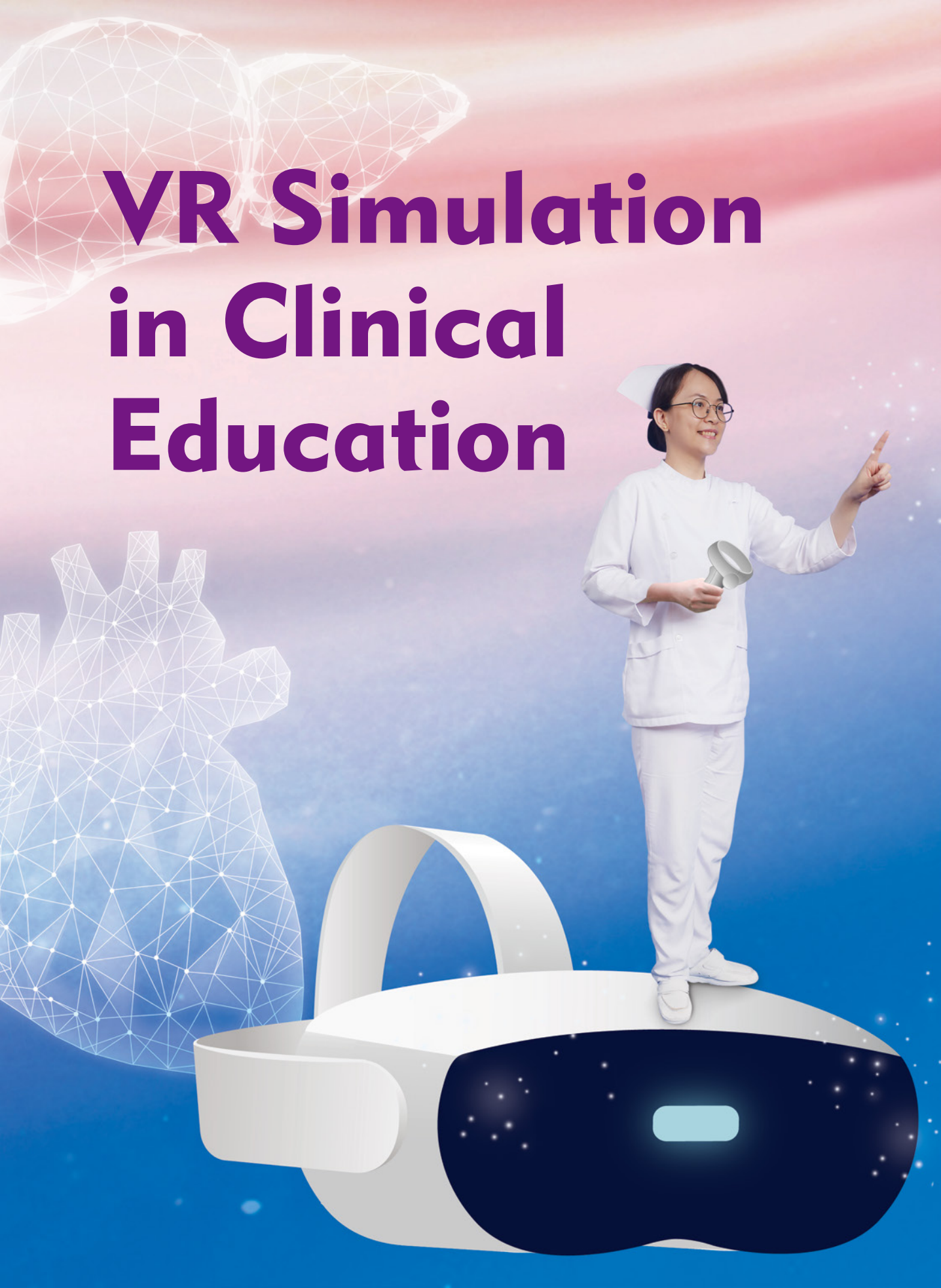


VR Simulation in Clinical Education



The background features a blue gradient with abstract wireframe shapes. A brain-like structure made of interconnected white dots and lines is in the upper left, and a profile of a human head with a similar wireframe structure is in the lower right. The text is white and positioned on the left side of the image.

Incorporation and Application of Simulation Technology in Tzu Chi Clinical Nursing Education

Chen Yi-Lin, Head Nurse of Palliative Care Ward, Taipei Tzu Chi Hospital

With rapid technological advances, teaching aids have become more and more diversified. Simulation-based teaching, in particular, has turned into a top priority in the development of medical education. Due to the fact that medical operations are often urgent and irreproducible and internships and practical exercises faced severe limitations during the SARS and COVID-19 epidemics, schools and hospitals have started to adopt simulation-based teaching approaches including Virtual Reality (VR). 3D virtual worlds with visual and aural reality effects created through computer simulations offer highly immersive user experiences. Augmented Reality (AR) adds and merges virtual information and objects with real-world settings and environments and allows users to engage in interactions. Mixed Reality (MR) with VR and AR characteristics, on the other hand, offers realistic and highly interactive environments.

The cover story of this issue which is titled “Incorporation of Technology into Clinical Education/VR Applications” is based on an e-questionnaire survey of RNs at all Tzu Chi Hospitals. This survey aimed to gain a deeper understanding of experiences and perceptions of VR-based teaching among RNs as well as perceived competence enhancement and actual application of such approaches in the field of clinical education. The ultimate goal is to better meet the needs and expectations of clinical

Basic Statistics

Gender	Number of People	%
Female	997	91.1
Male	98	8.9
Total	1,095	100.0
Years worked in the hospital	Number of People	%
under 1	157	14.3
1.1~2	112	10.2
2.1~3	96	8.8
3.1~5	126	11.5
above 5	604	55.2
Total	1,095	100.0

Age	Number of People	%
under 20	19	1.7
21~25	277	25.3
26~30	234	21.4
31~35	146	13.3
36~40	110	10.1
above 40	309	28.2
Total	1,095	100.0
Department	Number of People	%
Internal Medicine	188	17.2
Surgery	153	14.0
Pediatrics	35	3.2
Obstetrics & Gynecology	45	4.1
Intensive Care & ER	206	18.8
Functional Unit	18	1.6
Kidney Dialysis	51	4.6
Operating Room	88	8.0
Outpatient Clinic	174	15.9
Palliative Care	27	2.5
Administration	16	1.5
Psychiatry	36	3.3
Others	58	5.3
Total	1,095	100.0
Job Title	Number of People	%
Registered nurse	860	78.5
Deputy head nurse	44	4
Head nurse	55	5
Supervisor and above	17	1.6
Case manager / functional unit	44	4
Nurse Practitioner / senior RN	75	6.9
Total	1,095	100.0

nurses in the planning and promotion of VR-based teaching activities. A total of 1,095 valid questionnaires were collected.

A Majority of Respondents have Participated in Simulation-based Teaching Activities

Due to the popularization of VR technology in recent years, it has found increasing application in the field of nursing education. Hospitals successively develop simulation-based lesson plans for clinical nursing training. The goal is to achieve immersive learning experiences (Shu et al., 2019) in the fields of emergency care, drug administration, general nursing techniques, and surgery processes through audiovisual effects and cultivate the clinical judgment and operation skills of trainees by utilizing simulated realities. The creation of non-repeatable simulated clinical scenarios ensures greatly enhanced learning motivation and learning outcomes.

51.8% of respondents state that they have previously participated in simulation-based teaching activities at school/college, hospitals, domestic or overseas conferences, or in the context of training courses. Conversely, 48.2 % have never participated in such activities.

30.7% and 29.3% of the aforementioned 51.8% of respondents, respectively, have participated in such teaching activities at their hospitals and in the context of school/college education or training courses. Only a very small percentage of respondents have taken part in such activities during conferences.

We expect simulation technology to play a major role with maximum effect in the field of clinical education.

Close to 50% of Respondents are Most Familiar with Simulated Emergency Care and Drug Administration

As nursing practitioners our primary concern is patient safety and avoidance of medical errors. Near misses which were always concealed in the past have received rising attention in recent years. Subsequently, it was advocated that any anomalies should be reported to create opportunities for organizational and process improvements and adjustments. Simulation-based education allows nursing students and trainees to make and experiment with mistakes in a virtual environment and thereby reinforce their memory of accurate steps.

As for the application possibilities of simulation-based teaching activities, 48.8% of the respondents in the survey of RNs employed at Tzu Chi Hospitals mentioned

Q1

Have you ever participated in technological simulation teaching activities at schools, hospitals, conferences, or courses in Taiwan or overseas?
(N = 1,095, multiple choice)

Nursing school 29.3%

Working hospital 30.7%

Conferences in Taiwan 7.0%

Overseas conferences 0.2%

Others 0.6%

Never participated 48.2%



simulated emergency care scenarios (allowing observation of emergency care team division of duties and teamwork from different angles), which is followed by simulated drug administration by nurses (assessment of patient symptoms, interpretation of doctor's orders, accurate administration of drugs, monitoring and assessment of efficacy and side-effects) and simulated nursing techniques (e.g., neonate nursing, simulated injections, and tube placement) accounting for 45.1% and 34.7%, respectively. Simulated organ dissections (presented in form of 3D models, detachable parts, cross-sections from different angles, or dynamic models), high-end mannequins (acute and critical care nursing, obstetric nursing, and internal medicine and surgical nursing), and surgery simulations (simulated endoscopic surgery training) constitute 27.2%, 24.8%, and 23.3%, respectively. This bears clear testimony to the diversified

possibilities of simulation-based education in the field of nursing education and training in different medical departments.

However, there was also a significant percentage of 25.9%, who didn't know how to use simulation technologies in teaching activities.

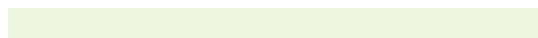
It is therefore evident that RNs are aware of the multiple uses of simulation-based teaching activities. Another important question is the actual participation in such activities under conditions of equipment and teaching environment limitations.

Q2

Technological simulation teaching can provide training or activities for clinical operations that are restricted. What technological simulation teaching activities are you aware of? (N = 1,095, multiple choice)

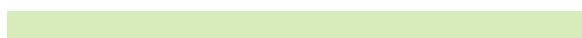
Simulated nursing medication administration 45.1%

(assessing patient symptoms, interpreting medical orders, correct medication administration, monitoring effectiveness and side effects)



Simulated emergency situations 48.8%

(observing emergency team coordination from different angles)



Simulated anatomical organ structures 27.2%

(displaying 3D models that can be disassembled or viewed from different angles, or dynamic models)



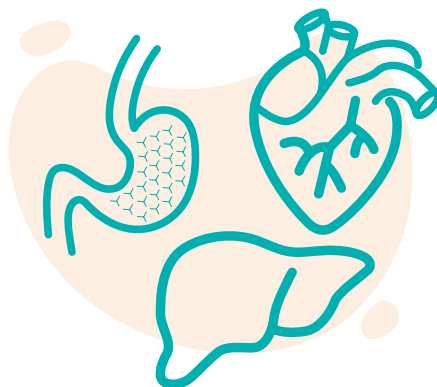
Simulated nursing techniques 34.7%

(such as immediate newborn care, simulated injections, tube placement)



Surgical simulation 23.3%

(simulated endoscopic surgery training)



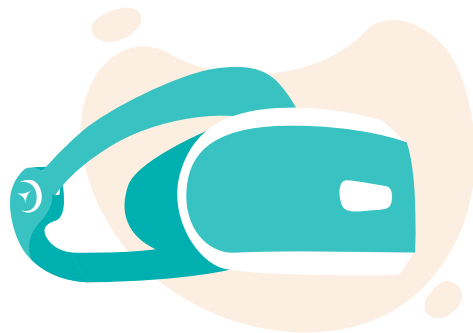
Advanced simulation mannequins 24.8%
(critical care nursing, obstetrics and pediatric nursing, medical-surgical nursing)

End-of-life care virtual reality, advance care planning virtual scenarios 15.5%

Disaster rescue virtual scenarios 13.6%

Others 0.6%

Don't know 25.9%



After deducting the number of RNs (284) who didn't know to apply simulation technologies to teaching activities, we asked the remaining respondents which simulation-based teaching activities they have participated in. Subsequently, they were asked which activities were most helpful. It turned out that the three top ranked activities in terms of participation rates, helpfulness, and awareness were simulated emergency care scenarios, simulated drug administration, and simulated nursing techniques in that order.

It is noteworthy that the values of every answer choice of simulation-based teaching activities deemed useful by the respondents for their training is significantly higher than those of activities they have actually participated in. Chen et al (2020)'s meta-analysis clearly indicates that all aspects of simulation-based training are superior to traditional teaching approaches in the knowledge dimension.

Learning without Time Constraints with Novel and Safe Simulation-based Teaching Activities

In addition to the provision of learning opportunities, the most important consideration for teaching activities is learning outcomes. 47.6 % of the respondents feel that clinical skills acquired through simulation-based teaching activities are at least a

little helpful for their clinical practices, while 39.5% believe that such skills are extremely helpful. It is therefore evident that 87.1% of the respondents acknowledge the positive effect of simulation-based teaching activities on the enhancement of clinical skills. Only 1.6% state that such activities are not helpful.

The aforementioned results clearly indicate that skills acquired in simulation-based training activities are universally applicable, extremely common, and vitally important for nursing practices of all medical departments. Nursing practitioners and students can acquire the knowledge, techniques, and communication and decision-making abilities

Q3

Which technological simulation teaching activities have you participated in?

(N = 811, multiple choice)

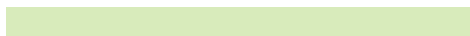
Simulated nursing medication administration 38.0%

(assessing patient symptoms, interpreting medical orders, correct medication administration, monitoring effectiveness and side effects)



Simulated emergency situations 39.5%

(observing emergency team coordination from different angles)



Simulated anatomical organ structures 10.0%

(displaying 3D models that can be disassembled or viewed from different angles, or dynamic models)



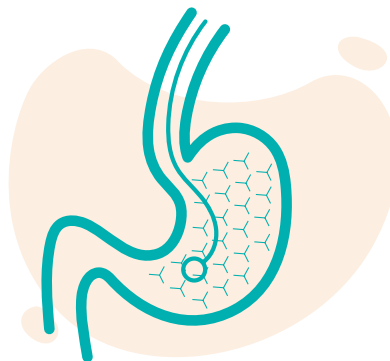
Simulated nursing techniques 23.9%

(such as immediate newborn care, simulated injections, tube placement)



Surgical simulation 4.4%

(simulated endoscopic surgery training)



Advanced simulation mannequins 16.0%
(critical care nursing, obstetrics and pediatric nursing, medical-surgical nursing)

End-of-life care virtual reality, advance care planning virtual scenarios 9.0%

Disaster rescue virtual scenarios 5.9%

Others 0.9%



associated with such skills and engage in repeated practice through the perception of VR-based visual images and situational experiences with real patients in a safe environment free of worries about negative impacts on patients (Chen et al., 2020).

Teaching attending physician Chen Yu-Lung at Taipei Tzu Chi Hospital actively promotes highly simulated teaching models. He guides acute and critical care nursing personnel in the formulation of lesson plans by utilizing the SimMan 3G practice system and the ACLS training model. In October 2019, the Department of Medical Education at Taipei Tzu Chi Hospital adopted VIVEPAPER, an augmented/VR enhanced reading experience APP. Development of VR-based lesson plans for all occupational categories has been initiated under the leadership of teaching attending physician Liu Tzu-Hung of the Department of Medical Education.

In fact, a large number of work-related situations in the field of nursing training require a synthesis of knowledge, techniques, and affection. However, a large percentage of such situations are not very common and impossible to anticipate. It is therefore quite difficult to conduct education when such situations occur without impacting patient safety. We have therefore started to learn how to utilize VR-based teaching models and simulated clinical-like settings and conditions with the ultimate goal of providing trainees with an immersive nursing practice and training environment. These training activities enable trainees to integrate their competence, skill operations, and teamwork abilities (Chen et al., 2020).

Research findings prove that the results of VR technology-based education in the field of skill acquisition are comparable to traditional teaching approaches, but in the knowledge enhancement dimension VR technology is superior to traditional training methods. Consequently, the Department of Medical Education has adopted related software and advocates the provision of each nursing unit with one VR headset for teaching activities to develop and popularize such activities in every unit.

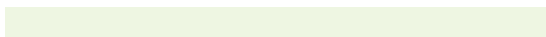
Q4

Which technological simulation teaching activities have been most helpful for your learning?

(N = 811, select up to 3 choices)

Simulated nursing medication administration 46.0%

(assessing patient symptoms, interpreting medical orders, correct medication administration, monitoring effectiveness and side effects)



Simulated emergency situations 57.1%

(observing emergency team coordination from different angles)



Simulated anatomical organ structures 20.0%

(displaying 3D models that can be disassembled or viewed from different angles, or dynamic models)



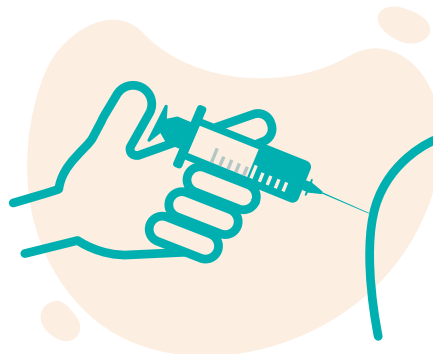
Simulated nursing techniques 30.1%

(such as immediate newborn care, simulated injections, tube placement)



Surgical simulation 11.2%

(simulated endoscopic surgery training)



Advanced simulation mannequins 24.5%
(critical care nursing, obstetrics and pediatric nursing, medical-surgical nursing)



End-of-life care virtual reality, advance care planning virtual scenarios 12.0%



Disaster rescue virtual scenarios 10.5%



Others 2.1%



Immersive Technology - Your Training Companion

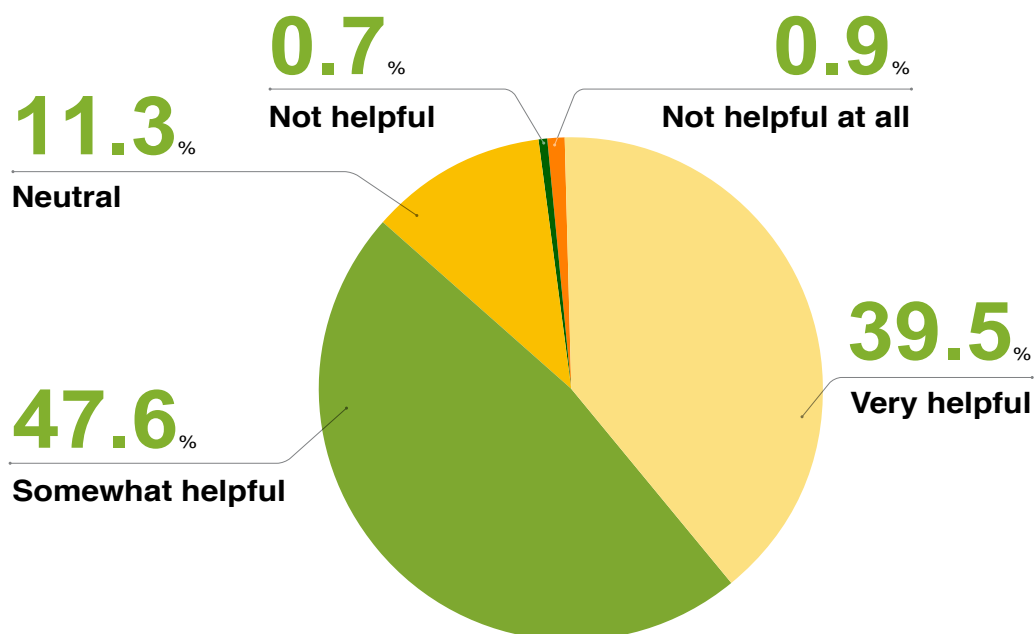
Our palliative care ward has created a VR training course titled “Immersive Technology – Your Training Companion” to instruct NPGY trainees in corpse care. The motivation for designing this course lies in the fact that corpse care is an essential nursing activity of short duration. In the course of interactions with grieving family members who have lost a loved one, our personnel can demonstrate their exceptional nursing skills. They know how to incorporate religious and cultural customs into the corpse cleansing and dressing process and are highly familiar with follow-up corpse processing procedures. They are also capable of providing spiritual care and comforting the mourning family members.

The latest research shows that over 90% of all nurses believe that care for dying patients is extremely challenging. Nursing personnel tend to experience fear, anxiety, despondency, helplessness, and even grief when facing dying patients or corpses (Hu et al., 2014). Nursing personnel who serve in the palliative ward frequently come in contact with dying patients and have to provide corpse care. The fact that it is difficult to provide novice guidance during actual operations triggered the motivation to utilize

Q5

Have the clinical skills learned through technological simulation teaching activities been substantially helpful in your clinical care practice?

(N = 811, single choice)



VR-based teaching approaches for the corpse care training of NPGY trainees. In the innovative teaching competition of the Nursing Department, the VR-based corpse care training course titled “Immersive Technology – Your Training Companion” earned the approval of the judges. It was therefore listed as one of the hospital-wide OTJ training courses for newly hired nursing staff in March 2021. It has also been adopted as a holistic care education course for nursing interns. As of December 2022, 236 RNs and 926 nursing interns have attended this course. Course satisfaction ranges from 96.1%-97.6%. As much as 98.7% of all course participants agree with the following statement: “The contents of the VR-based teaching system have aroused my learning interest”. In addition to these high satisfaction levels, the professional knowledge and understanding of RNs and nursing interns has also increased significantly, which is reflected in the fact that post-test scores exceed post-test scores by 14.5 to 14.9 points.

Results of VR - integrated Teaching are Highly Lauded

The process of VR-based education promotion clearly demonstrates that advanced information technology can free nursing training from spatial and temporal limitations and difficulties caused by low case incidence. It also shows that it is possible to utilize VR-based realistic scenarios and activities which are perceived as authentic by trainees and sensory gear which generates sensory stimuli and thereby enable trainees to gain immersive experiences, acquire new knowledge and skills, view problems from different perspectives, and engage in repeated operations with the goal of achieving optimal learning outcomes. In addition to high cognition and satisfaction levels, trainees who have experienced the “Immersive Technology – Your Training Companion” lesson plan have given the following feedback: 90.4% and 91.5% of the respondents, respectively, state that they are “less afraid than before when performing corpse care” and that they “know how to perform corpse care.” 92.3% feel that “this course is ideal for trainees or newly hired staff members who have no experience in the processing of corpses.” 93.5% believe that “simulated authentic experiences reinforce impressions of learned contents.” This feedback highly acknowledges the benefits of simulation-based education.

The training task force of the Nursing Department at Taipei Tzu Chi Hospital promotes the formulation of simulation-based lesson plans and VR video shooting for lesson plans utilized for NPGY trainee and NP education. As a result of tireless efforts in the period from 2020 to 2023, a wide range of VR-based lesson plans for NPGY and NP training including “Emergency Drug Administration”, “Care for Epileptic Patients”, “Cardiopulmonary Rehabilitation”, and “CPR and First-Aid Measures” have been completed. Furthermore, a VR-based lesson plan titled “What will I Face in the ICU After Anesthetized Surgery” has been developed for patients as a pre-surgery nursing guide.

In conclusion, advanced digital technology creates both new opportunities and challenges for nursing education. Nursing practices require professional knowledge and skills with a strong emphasis on patient safety. Training processes must therefore be extremely strict and rigorous. Certain skills and techniques require long-term observation, practice, and evaluation. The adoption of new technologies for nursing education unlocks simulated experiences, drills, and interactive learning (Huang, 2022). Newly hired nursing staff have more opportunities to engage in experiential learning, which results in higher skills proficiency and thereby enhanced medical care quality.