Chapter

Nursing XR Simulator for Diversity, Equity, and Inclusion: A New Purpose of Future Technology Development

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Abstract

XR is a term within the spectrum of virtual reality (VR), mixed reality (MR), and augmented reality (AR). In 2015, Endotracheal Suctioning Training Environment SIMulator (ESTE-SIM) project team was established (PI: Noriyo Colley), which consisted of a wide range of disciplines including nursing science, information science, and healthcare engineering to promote the development of a pedagogical environment for quality care through simulation education. Mutual recognition was found that a digital transformation plays an important role to mitigate the risks of global shortages of nurses and healthcare faculty due to pandemic, ultra-aging society, and technology dependent children such as children with home mechanical ventilators. Nursing XR simulators are being developed for Diversity, Equity & Inclusion, which is a new purpose of future technology development.

Keywords: VR/MR/AR/XR, home-ventilator, curriculum evaluation, nursing education, system thinking

1. Introduction

New graduate nurses, to varying degrees, experience the "Theory-practice gap" in their first year after graduation [1–5]. Generally, after obtaining a nursing license, students attend a training course for new nurses run by the nursing manager at their place of employment and begin nursing work through a different type of apprenticeship system, such as a preceptor system [6] or a buddy system [7], acquired through On the Job Training (OJT) [8], continuing education, and postgraduate education.

The skills required are completely different in chronic wards, which mainly require psychological support and health education for patients, and in acute wards, which mainly deal with emergencies, such as perioperative nursing and accepting emergency transport [9]. If there is a large discrepancy between "the expectations of new nurses" and "the practical skills required in the ward," this can lead to burnout syndrome, depression, and early turnover.

Hiraga and Fuse analyzed the constituent factors of reality shock through a questionnaire survey and extracted 8 items: "human relations in the workplace," "nursing practice ability," "physical factors," "mental factors," "busy work and treatment", "worthiness and enjoyment of work," "sense of responsibility toward work," and "response to patient's death" [10]. The results showed that new nurses were especially likely to experience feelings of loneliness and self-doubt due to having few people to consult. They reported that they felt reality shock due to their "mental factors" and their "nursing practical ability," which meant they were unable to respond to critically ill patients or sudden changes and lost their confidence [10].

In contrast to Hiraga and Fuse's analysis of personal impact of reality shock, Labrague (2024) revealed the association between reality shock and missed nursing care from systematic point of view, which indicates that reality shock diminishes quality of care in the hospitals/institutions. A significant contribution of her study is to distinguish reality shock from the newly graduated nurses' attribute as a pedagogical issue with high priority to solve [11].

In recent years, there have been many reports of collaboration efforts between one educational institution and one medical institution since Dean Rozalla Schlotfeldt at the School of Nursing at Case Western Reserve University tested a plan for formal collaboration between education and service with the university hospitals in 1961 [12].

The construction of an inter-organizational system called unification has been standardized since the 1980s to resolve the gap in consciousness caused by differences in positions. Unification is a system for educating nursing students and new nurses through collaboration between educational institutions and institutions that accept clinical training. In the United States, unification is a system that fosters the professional awareness and autonomy of nurses. Reported benefits include promotion, opportunities to demonstrate professional abilities, promotion of joint research at universities, and effective continuing education [13]. Additionally, Lambert et al. pointed out the benefits of unification: (1) guarantee practical opportunities for faculty, (2) develop organizational mechanisms for clinical practice, clinical research, and clinical supervision by faculty, and (3) encourage faculty to promote the integration of practice and research, (4) building financial support and mechanisms to promote unification, and (5) providing opportunities to support teachers in acquiring new roles [13]. Nowadays, the unification system has developed to involve multiple educational institutions [14].

Although the unification system varies, clinical practicum in undergraduate nursing education is basically an important opportunity for nursing students to apply the knowledge and skills they have acquired on campus to nursing practice in actual clinical settings, and while it has the meaning of alleviating reality shock for new nurses, rather than opportunity to enhance collaboration between education and service. There is also a clinical ladder system as a countermeasure for clinical wards accepting newly licensed nurses [15], but in this chapter, we focus on the side of undergraduate nursing education to reduce reality shock also known as Theory-practice gap.

To reduce the "Theory-practice gap", one characteristic of Japanese regulation needs to be addressed. The Article 17 of the Medical Practitioners Act states that "no one who is not a medical doctor may practice medicine." Even if it is a skill that is required to be performed after obtaining a nursing license under the direction of a doctor, such as endotracheal suction, if the skill is classified as an invasive medical procedure, nursing students are allowed to "only observe" during the practical training [16].

Although approximately 30 years have passed since home ventilator management fees were included in medical reimbursement in 1990 [17], ventilator care, such as endotracheal suctioning and tube feeding is still being conducted regarding the skills

that parents of children with home ventilators can perform as part of "medical care", not "medicine". The situation continues where nursing students are only allowed to observe during their clinical practicum, and if this is left unchecked or excluded from the development of healthcare system, it will not only maintain a social structure in which the care needs of children with disabilities and their parents are not met in the context of home care or special needs schools. It is not hard to imagine that the shortage of nurses who can handle ventilators will be repeated due to the international spread of coronavirus infection from 2019 to 2022.

Therefore, this chapter aims to reflect on the three years of the COVID-19 pandemic in preparation for the future and to examine the "Theory-practice gap" in nursing education from the perspective of the SDGs and curriculum development that complies with international standards.

2. Methodology

In this chapter, we are going to discuss (1) the formal-educationalized process of technological innovation and new technology, (2) understanding learners' needs to include learners' voices, (3) global standardization of nursing education for a sustainable society, and (4) Endotracheal Suctioning Training Environment SIMulator (ESTE-SIM) project, which integrates Digital transformation (DX) into nursing education to reduce the Theory-practice gap.

3. The formal-educationalized process of technological innovation and new technology

To obtain a medical practitioner's license in Japan, it is necessary to have practical experience in medical treatment under the guidance of an appropriate instructor during clinical training during the fourth to sixth years of medical school. Article 17 of the Medical Practitioners Act mentioned above also applies to medical students, and the guidelines for medical acts that medical students can perform during clinical training are based on the "Clinical Practice" compiled by the Health Policy Bureau of the Ministry of Health and Welfare (at the time) in 1991. The basis for this has been the Final Report of the Practical Training Review Committee (Maekawa Report) [18].

However, as medical technology and medical practices have made dramatic advances that medical students should experience and acquire have diversified. In 2018, the Ministry of Health, Labor and Welfare's Medical Ethics Council Physician Subcommittee decided to "The range of medical activities (required and recommended items) that can be performed in clinical training at medical schools" [18]. In addition, in consideration of the lack of practicality of pre-graduation education, the duplication of pre-graduation and post-graduation education, and the lack of a continuous education environment for pre-graduation and post-graduation, a revised medical education model core curriculum applies from 2024 new students.

The Japanese Society of Medical Education took the lead in considering the revised plan, and creative ideas such as adding study strategies and evaluations, and digitization were implemented. This is revolutionary in that it allows medical students who pass the exam to legally practice medicine through participatory clinical training [18].

Regarding nursing education, the number of universities increased from 11 in 1991 to 303 in 2022 in Japan [19], making universities the largest number of nurse training

schools for the first time. Recent changes in educational content include the growing need for appropriate healthcare provision systems such as regional comprehensive care systems and remote nursing due to the declining birthrate and aging population, and the introduction of information science technologies such as AI (Artificial Intelligence) and machine learning. As the field of nursing is rapidly progressing and the field of activity for nurses is expanding, the ability to deal with the diversity and complexity of the subjects is now required.

The Ministry of Health, Labor and Welfare has compiled reports on curriculum revision proposals 10 times since 2018, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has held a "Study meeting about the nursing undergraduate education system and human resources". In response to these trends, a report was compiled in December 2019 on issues and countermeasures regarding the application of the regulations for designation of public health nurse midwives and nurse school training centers [20].

According to a survey on the impact of the coronavirus pandemic on training conducted by the Japan Association of Nursing Programs in Universities (JANPU), among 247 schools out of 287 member schools (response rate 86.1%) of JANPU as of October 2020, more than 70% of nursing universities have canceled practical training or switched to on-campus training [21].

Based on the results, a team was formed to create a plan for (1) Organizing the current issues in nursing clinical training and creating a new clinical practicum framework proposal, (2) Organizing the issues related to digitalization in nursing education, and framework for nursing education in the DX (Digital Transformation) era. 14). In August 2020, the Ministry of Education, Culture, Sports, Science and Technology's "Leading University Reform Promotion Commission Project" for the revision of the nursing education model core curriculum in 2020 was announced [22]. In response to this research, JANPU conducted an AI chat survey in 2023 regarding the nursing education model core curriculum. The aim is to create a revised proposal for the next "Nursing Education Model Core Curriculum" by clarifying "competencies and the educational content necessary to achieve them". The result is going to be reported in February 2024 [23].

4. Understanding learner needs

4.1 Expansion of opportunities for nurses and required education

With the expansion of home-based services in the ultra-aging population and technological development, an increasing number of nurses are working in a variety of settings other than medical service facilities, such as visiting nursing stations, nursing care facilities, and special needs schools. For this reason, nurses are expected to collaborate with other professions expanding their roles, and the designated regulations that have been in effect since April 1, 2020, stipulate that 3-year nursing courses, including those at universities, require "the structure of the human body." The number of credits for "Functions" and "Promotion of disease development and recovery" will be increased by 1 unit from 15 credits to 16 credits, and the name of "Home Nursing Theory" will be changed to "Community/Home Nursing Theory", the total number of credits increased by 5 credits to 102 credits, including an increase of 2 credits from 4 credits to 6 credits [24].

Some universities include a public health nurse or midwife course during the four-year period, and students are required to earn 31 credits in each course in addition

to the nurse course. In the 5-year high school nursing department qualify to take the national nursing exam which is the earliest course to become a registered nurse. Some courses qualify students to take the national teacher's exam and gain clinical experience after obtaining an enrolled nursing license and earning credits through correspondence education [24]. While the existence of a variety of courses increases the number of options for students in difficult economic situations, there is a negative side in that enrolled nurses are treated differently than registered nurses and the principle of equal pay for equal work is not observed. A nursing education system that allows motivated individuals to receive fair economic evaluation is desired. Uchiyama et al. note that the number of students applying to nursing universities is increasing due to the tendency to place more emphasis on obtaining qualifications and finding employment, but it is not always the case that students are applying to nursing universities based on their own intentions, in this case, the ratio of drop out and transfers are increased [25].

4.2 Chronic and sudden nursing shortages and their effects

Shortage of nurses increases the need to expand the scope of practice for individual nurses no matter how they want or not. Looking at the chronic shortage of nurses, the most significant change has been the partial revision of the Social Workers and Care Workers Act in 2011. One example of this is that endotracheal suction and tube feeding ("medical care") have been designated as actions that can be performed by those who have completed training [26]. Medical care, which until then had been limited to doctors and nurses' license holders and their families due to the theory of illegality, can now be provided by training such as phlegm suction provided by a registered organization, allowing advanced medical care to be provided at home. Accessibility to healthcare services for people who require medical care e.g., home-ventilators, have increased.

Acquired the knowledge and skills necessary to perform sputum aspiration (intraoral, intranasal, and tracheostomy suction) and tube feeding (tube feeding through gastric or intestinal fistula, nasal tube feeding), home care workers (including certified care workers) will be able to perform sputum suction and tube feeding under certain conditions, and it has been favorably approved as it will expand the scope of practice for care workers, etc. On the other hand, there are cases where the increase in responsibility resulting from the training is viewed negatively, as there has been no change in economic evaluation. This system plays a role in maintaining the quality of life of elderly people and children with disabilities who have been unable to receive enough services due to uneven distribution of doctors and a shortage of nurses. Sputum aspiration and tube feeding were added to the university curriculum for training certified care workers for students enrolled in April 2015 [26].

On the other hand, a specific training system for nurses was launched in 2015 to counter the shortage of doctors and improve accessibility to care services. This system allows nurses to change ventilator settings, replace tracheostomy tubes, operate, and manage percutaneous cardiopulmonary support devices, etc. based on comprehensive instructions from doctors in advance, and as of September 2021, 4393 nurses completed the course [27].

From 2024, the upper limit on working hours for medical practitioners will be 960 hours per year, and the trend toward task shifting and sharing in medical practice will have a major impact on the scope of practice of nurses and other medical professionals. Clinical engineers are responsible for connecting infusion pumps or

syringe pumps to intravenous routes, operating the infusion pumps or syringe pumps for administering drugs, and removing needles, hemostasis, and endoscopy after administration of the drug is completed, and the operation of a mirror video camera was added [28]. Clinical laboratory technicians use a medical suction device to collect sputum from the nasal cavity, oral cavity, or tracheal cannula and use endoscopic biopsy forceps to collect a portion of tissue from a lesion in the gastrointestinal tract were added [29]. Other approaches are being attempted to promote automation, such as health management devices using wearable sensors, defibrillators such as AEDs that do not require medical qualifications, automation of diagnosis using machine learning, and surgical support robots for remote medical services. Although there are some opinions against automation, it is considered necessary to make constant efforts to introduce new technologies into clinical settings, the research ability to keep updating service, and IT literacy to build a new medical care delivery system through automation and mechanization.

One example of a sudden shortage of nurses is the shortage of nurses due to the coronavirus pandemic from December 2019 to May 2022. The duties required of nurses have increased, including mechanical ventilator management in ICUs, care for patients on ECMO, response at cluster outbreak facilities, infection control duties such as zoning, vaccination duties, and care of patients receiving home care [30].

The Japanese Nursing Association (JNA) states that the reason why it has been difficult to secure nurses in hospitals, etc. is due to the small number of nurses in normal times. When dealing with a patient on a ventilator, there needs at least 1 nurse to 1 patient, when dealing with a patient on ECMO, there is at least 1:2 nurse, and when dealing with a patient on ECMO, there is a need to change positions although six or more nurses are required to perform the procedure including prone positioning. The number of nursing staff per bed is 4.1 in the United States, 3.1 in the United Kingdom, and 3.9 in Canada, while the number of nurses in Japan is as low as 0.9, ranking 30th out of 35 OECD member countries as of fiscal 2017 [30]. JNA believes that there is a need to develop nursing professionals who can care for patients on ventilators and manage infection and proposed the creation of a nurse support dispatch system in the event of a cluster outbreak [30].

As of November 2023, the Ministry of Education, Culture, Sports, Science and Technology's budget request for fiscal year 2024 is expected to call for public applications for "nursing training projects that can respond to social demands. [Theme 1: The training of nurses to take leadership positions in supporting technology-dependent children in the community and special schools], and [Theme 2: The training of nurses who can handle critically ill patients (including OJT)]. The target projects are to train nurses who can use mechanical ventilators and ECMO in hospital wards [31]. In particular, [Theme 1] includes educational content for nursing undergraduate students to carry out practical training to support technology-dependent children and includes enrichment of pre-practical OSCE and simulation education for nursing undergraduate students. Careful consideration is required to build a curriculum and secure instructor nurses for training sites.

4.3 Ethical considerations in nursing education

Curriculum development based on the social demand for care as described above is based on educators' reflections, including regional characteristics such as accessibility to services, prevalence rates, and aging rates in the achievement level

at graduation. While this is possible, there is a risk that it will result in a curriculum that emphasizes cramming education and immediate skills for care service consumers. Reducing the "Theory-practice gap" and creating a curriculum that guarantees students' independent learning opportunities, rather than unilateral guidance by educators, and respecting students' dignity as mature individuals are urgent tasks.

5. Global standardization of nursing education

5.1 The PEPPA framework

The shortage of doctors and nurses is a common issue both domestically and internationally. In addition to the unpredictable restrictions on educational opportunities caused by the coronavirus pandemic, the lack of services due to the super-aging population is also becoming a global health issue. Internationally, an increasing number of universities are using the Participatory, Evidence-based, Patient-focused Process, for Advanced practice nursing (PEPPA) framework as a reference for curriculum development. The PEPPA framework was developed through participatory action research and was published by Bryant-Lukosius D and Dicenso A in 2004 [32]. The usage method is as follows.

1. Defining the patient population and describing the current care model

2. Identifying stakeholders and recruiting participants

3. Determining the need for a new care model

4. Setting priority issues and goals to improve care models

5. Defining new care models and the role of advanced practice nurses

6. Formulation of plan implementation strategy

7. Start of introduction plan for advanced practice nurses

8. Evaluation of the role of advanced practice nurses

9. Long-term evaluation of the role of advanced practice nurses and care models

The roles expected of nurses differ greatly depending on whether the patient group is a single surgical ward, an isolation ward with coronavirus-affected patients, or a local special needs school. The PEPPA framework includes a process that incorporates the opinions of stakeholders such as patients/children and families to reach consensus on the role expectations of nurses.

It is conceivable that on-the-job training for nurses may be necessary to implement a new care model. Boman et al. used the PEPPA framework to examine the practical skills required of nurses working in emergency departments in Norway [33]. It is impossible to include all the knowledge and skills needed in all practical settings in undergraduate formal education, and it was considered necessary to connect and maintain continuity between undergraduate and post-graduate education.

5.2 Swift development of DX in healthcare delivery and nursing education

Due to the global pandemic of coronavirus, development of DX in nursing education is also actively underway. As it reduces risks for both patients and nursing students, the efficacy of XR simulators has obtained international consensus. We are now in an era where students wearing VR goggles can talk to virtual patients as an alternative/supporting material before clinical practicum. Unfortunately, in the nursing VR platform, there are skills that are considered duties of nurses overseas that cannot be performed in Japan. In Sweden, there is a system called the Personal Assistant system that allows people with disabilities to directly hire care providers, and the content of care and remuneration are decided between the care service user and the provider. In April 2010 the Personal Assistant system was introduced in Sapporo City in Hokkaido prefecture in Japan, but unlike the Swedish system, it remains an unfair distribution of healthcare in terms of related laws and regulations [34].

The nurse practitioner, which has been introduced in countries such as the United States and Australia, is a professional who can prescribe, diagnose, refer to other departments, and claim medical remuneration, and who can perform a part of medical treatment independently without medical practitioners' direct/indirect supervision, the name is exclusive under related laws and regulations [35].

The flexibility of the healthcare delivery system provides opportunities to improve the quality of life of patients/children and their families by expanding the scope of practice and the capabilities and sense of control of care providers, including patients, people with disabilities, parents, special-need-school teachers, and nurses. As we have seen, in Japan, the formal educationalizing process for new technologies accompanying technological development is a strict system that requires legal revision, but flexible working between medical professions is possible in the event of an emergency such as a pandemic. The time has come to consider building a flexible system that will prepare for future shortage of nurses, and the time has come to promote it as a concrete example of social capital. DX could be a primary solution for this issue.

Professor Andrew Cashin at Southern Cross University in Australia, a Nurse Practitioner specialized in autism, commenced a project to increase awareness of RNs toward care for children with autism spectrum disorders in 2023 [36]. Using IT technology to disseminate professional knowledge and attitudes, Australian RN license holders can update their provision of care anywhere and anytime even living in Japan. His project is a valuable contribution that serves as a typical touchstone for the international standardization of nursing continuous education as well as increasing quality of care for children and their families internationally through empowering Australian nurses.

Mutual recognition between information technology and healthcare technology was found that digital transformation plays an important role in mitigating the risks of global shortages of nurses and healthcare faculty due to the pandemic, ultra-aging society, and technology-dependent children such as children with home mechanical ventilators.

6. ESTE-SIM project

Nursing XR simulators have been developed to popularize the concept of Diversity, Equity & Inclusion, which is a new purpose of future technology development. In 2006, the pros and cons of having helpers perform endotracheal suction for

children with tracheostomies attending nursery schools and for ALS patients living at home were questioned. Approximately 30 years have passed since home ventilator management fees were included in medical reimbursement in 1990 in Japan, what we have experienced was sudden unexpected shortages of nurses during COVID-19 global pandemic. To secure each child's right to receive education by increasing the number of people who can provide home-ventilator care, the Endotracheal Suctioning Training Environment SIMulator: ESTE-SIM project has started with the agreement of Professor Shinji Ninomiya at Hiroshima International University in Japan in 2015 [37], with a belief that care providers who have received a certain level of nursing education based on social demand of care should be increased, not limited to conventional healthcare education to contribute as social capital for everyone who has disease/disability or not (see supporting materials).

6.1 ESTE-SIM

The ESTE-SIM (**Figure 1**), which enables realistic training of endotracheal suctioning, can measure the movements of the suction catheter inserted in the artificial trachea. The load sensors surrounding the artificial trachea send information on pressure by the tip of suctioning catheter is used to estimate the progress of the nursing maneuver, which is then used to reproduce vital reactions on a display as a simulated pulse oximeter, and virtual facial expression changes on a patient facial mask based on dynamic projection mapping technology [38, 39]. This is the first case of nurse-initiated simulator development for endotracheal suctioning in Japan, protecting patients and nursing students from risks of tracheal injuries and accidents. Repetitive practice with prompt realistic biological reactions allows nursing students to increase their motivation and confidence to provide care [40].

While the size of the trachea varies across different age groups, the artificial trachea model in the simulation system had only one fixed model. The development

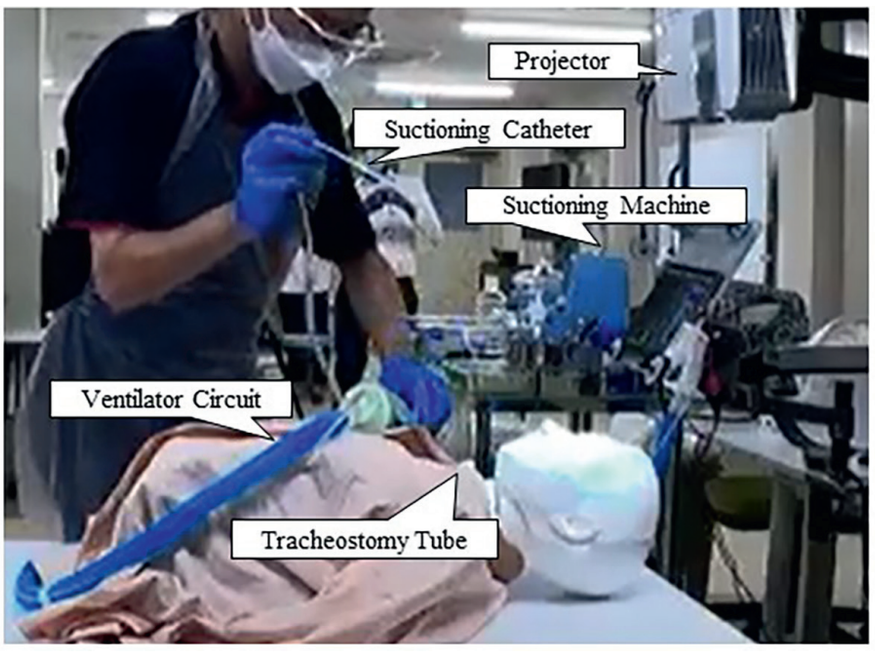

Figure 1.
ESTE-SIM.

of the artificial trachea was supported by a Radiologist, Assistant Professor Takaaki Yoshimura. To construct the artificial trachea model for three age groups (children, adolescents and young adults, and adults), we analyzed the three-dimensional coordinates of the entire trachea, tracheal carina, and the end of the main bronchus from the treatment planning computed tomography (CT) image data [41].

6.2 ESTE-mobile

Endotracheal suctioning is considered a procedure that should not be performed without licenses, including medical and nursing students before they obtain their license. Because of its invasive characteristics, opportunities to observe suctioning procedures are limited during practicum. Therefore, we developed Two-Dimensional (2D) video and Three-Dimensional Computer Graphics (3DCG) videos (**Figure 2**) to provide educational means and opportunities for more people, including family caregivers to access knowledge for safe endotracheal suctioning [42]. Improvement of user-friendliness of the video for the instruction of operation method and adding explanations in the 3D video are needed. Both 2D and 3DCG videos seemed effective according to the questionnaire, future challenge is to measure the influence of learners' eye movement analysis by calculating dynamic velocity frequency analysis for learning effectiveness.

This enhances the opportunity to access education materials for family caregivers of children with home mechanical ventilators as well. Including family caregivers' experience in developing the simulator is another challenge that respect their opinion. The experience will spread and shared among family caregivers and become foundation of social networks.

Figure 2.
ESTE-mobile.

6.3 ESTE-Holo

Nursing Educators must know effective maneuvers of suctioning catheters to teach students. There is a need to develop a suction simulator that can quantitatively assess the techniques of suction catheter manipulation. we developed a tracheal model with measurement functions: the measurement of the pushing force of the catheter on the bronchial bifurcation wall by the force sensor and the detection of the catheter tip trajectory history by the camera implemented [43]. Sensor data was then sent to change facial expression through Microsoft HoloLens 2 with a pupil eye tracker (**Figure 3**). This research topic expanded to compare five catheter maneuvers for the most effective suctioning phlegm within 10 seconds duration on the artificial tracheal membrane [44].

6.4 ESTE-360

To reflect students' and special needs school nurses' opinions on the development process of educational materials, the 360-degree panorama video (**Figure 4**) was created. A 360-degree video at a special need school was developed after permission from the students, their families, teachers, and the president of the school, then Adobe Premiere Pro was used to blur the face to make the individual unidentifiable. Insta 360 ONE was used to record and PICO G2 4K was used to view the video. Original questionnaire was created by Google Forms using 4 Likert scale to ask if the video was handy, real, motive, enough time, good balance of time and contents, adequate for third graders, and adequate for fourth graders. The result indicated that B3 is appropriate to start learning a lecture with a 360-degree video, and 4th grade would be the best to learn HV care at practicum [45].

A student with her home mechanical ventilator cooperated to develop the 360 videos. She showed her school life while she was studying by a tablet or with speech therapists. Different from suctioning for an unconscious patient in an Intensive Care Unit, her tracheal suctioning procedure was special and the timing was eye contact between her and a nurse. She removes the artificial air filter on her tracheal tube

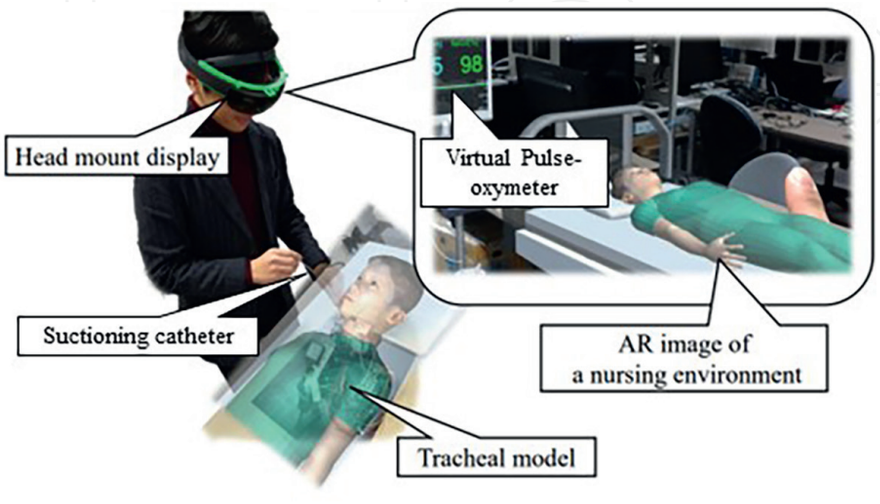

Figure 3.
ESTE-Holo.

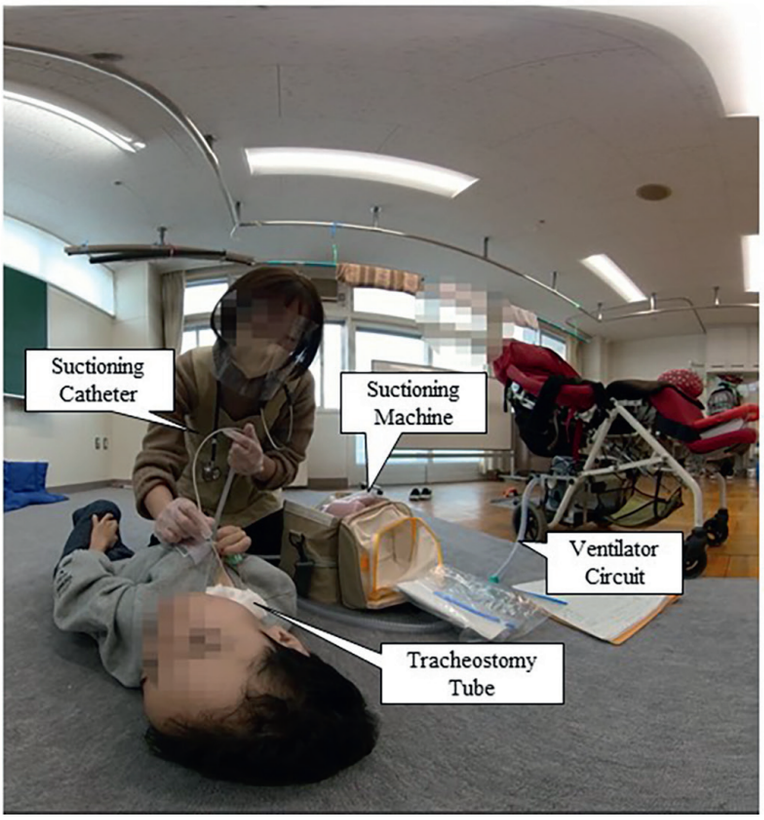

Figure 4.
ESTE-360.

before suctioning, then the nurse inserts the suctioning catheter to suction, and then she returns the artificial air filter back to her tracheal tube.

Suction is not just the act of sucking sputum with a suction catheter. The timing of catheter insertion is important because breathing is not possible during suction. It could be a non-verbal communication to build trust relationship between children with tracheostomy. It was effective in informing students the realm of suctioning in a special-needs school setting, in addition, to ask participants' opinion about the appropriate time to start studying endotracheal suctioning and home-mechanical ventilator at special-needs schools. The accumulation of these careful nursing actions protects her livelihood, guarantees her the opportunity to receive an education, and opens the door to her future participation in society.

7. Conclusion

Society requires individual nurses to provide safe nursing techniques and expects nursing educators to construct an educational system to achieve this. The PEPPA framework makes it possible to define the role of nurses and care models for targeted populations. There is a potential to be applied as formal nursing curriculum evaluation criteria to satisfy social care demand which contributes social inclusion of children with home-ventilators. In medical education, a system has been established for medical students to acquire skills during practical training, such as legal modification of medical practice through a participatory clinical training system. By creating a similar system, we can assure nursing students to reduce the "Theory-practice gap".

With the development of information science and technology, skills such as learning programming and understanding and utilizing AI are also required. Programming learning begins in elementary school, so students with such skills will enter nursing universities in near the future. It is also important to ensure opportunities for teachers to improve their skills. If we utilize a new technology carefully, DX might improve the efficiency of unification to bridge the Theory-practice gap and accessibility of education for children.

In 2006, the pros and cons of having helpers perform endotracheal suction for children with tracheostomies attending nursery schools and for ALS patients living at home were questioned, but now nurses are assigned to special needs schools. By having a teacher accompany the student to receive training such as sputum suction, it has become possible to reduce the time required for family members to accompany the student while their students are studying at school. Although some degree of negative impact on quality of life is unavoidable depending on the individual's health level, such as the presence or absence of congenital diseases or disabilities, burnout among family caregivers, and decline in self-esteem among ventilator recipients are avoidable. It can be reconsidered as an event that can be predicted or prevented by improving systems and providing sufficient services.

It is necessary to further consider the development of flexible and timely formal educationalization procedures for new healthcare technologies, the avoidance of cramming by understanding the needs of learners, and curriculum development and evaluation methods in accordance with international standards. When we open our eyes to the issues, concrete solutions will appear in front of us. Restricting nursing skills by laws and regulations widens the scope of practice of the nurse and results in the quality of care for the patient/children and their families.

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