Received: 1 March 2021 | Revised: 20 May 2021 | Accepted: 19 July 2021

DOI: 10.1002/nop2.1017

RESEARCH ARTICLE

NursingOpen Open Access WILEY

Evaluation of students' perceived clinical competence and learning needs following an online virtual simulation education programme with debriefing during the COVID-19 pandemic

John Tai Chun Fung | Wen Zhang | Man Nga Yeung | Michelle Tsz Ha Pang | Veronica Suk Fun Lam | Bobo Kai Yin Chan | Janet Yuen-Ha Wong

School of Nursing, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Hong Kong, Hong Kong

Correspondence
John Tai Chun Fung, School of Nursing, Li Ka Shing Faculty of Medicine, The University of Hong Kong, SAR 4/F, William MW Mong Block, 21 Sassoon Road, Pokfulam, Hong Kong, SAR.
Email: bigjohn@hku.hk

Abstract

Aims and objectives: This study aimed to evaluate the effect of a virtual simulation education programme with debriefing in undergraduate nursing students. Perceived clinical competence and learning needs of students in a simulation environment were also measured.

Background: Evidence showed virtual simulation education programmes provided better knowledge acquisition. However, these studies to date did not incorporate virtual simulation in the combination of a debriefing model in nursing students.

Design: A one-group pre-test and post-test design.

Methods: 188 final year undergraduate nursing students participated in the study. Linear mixed model analysis was conducted to evaluate the effect of the programme.

Results: Students have perceived a significant improvement in clinical competence and nursing process. Self-efficacy has also boosted. Communication and critical thinking were applied better in the traditional clinical environment.

Conclusion: Perceived clinical competence of Chinese nursing students has significant improvements by using virtual simulation combining a debriefing model during the COVID-19 period. Virtual simulation met students' learning needs. Future studies should include a control group for comparison and long-term measurement.

Relevance to clinical practice: The study provided an innovative clinical learning pedagogy to serve as a potential alternative with traditional clinical practicum during the COVID-19 period as this is substantially limited.

KEYWORDS

clinical competence, clinical decision-making, facilitated debriefing, nursing education, virtual simulation

1 | INTRODUCTION

The first patient with coronavirus disease (COVID-19) in Hong Kong was confirmed in 2020. At the time of writing, there had been more than 10,000 COVID-19 cases and 200 deaths in Hong Kong (Department of Health, 2020). COVID-19 has presented us with unique and difficult challenges for clinical teaching and learning as the undergraduate nursing clinical practicum was suspended. The final year nursing students suffered the most significant impact owing to a severe deficiency of clinical hours required for skill consolidation and clinical competencies. Thus, an online nursing education programme should be developed to ensure they have sufficient clinical hours before their licensure. Building on the simulation education in nursing programmes worldwide, we developed a virtual simulation education programme to respond to students' learning needs and combat the teaching impact of COVID-19. In the educational programme, virtual simulation combined and integration with an immediate postsimulation debriefing in the Zoom platform was used. It provided students with realistic clinical experiences and meet their learning needs. This research paper aimed at providing evidence for perceived competence and learning needs after participating a virtual simulation programme.

1.1 | Virtual simulation in clinical education

Virtual simulation is a type of simulation that places humans in a central role by exercising motor skills and decision skills (Padilha et al., 2019). This is a relatively novel pedagogy in clinical and nursing education, and it is rapidly emerging due to the current COVID-19 situation. From a recent meta-analysis, not many studies have quantitatively studied teaching using virtual simulation in the nursing curriculum (Shin et al., 2019). The current COVID-19 situation provided a precious chance to investigate the effectiveness of virtual simulation implementation in the clinical nursing curriculum. Several recent studies have shown that virtual simulation has gained increasing popularity for engaging students' active participation in cognitive, affective and psychomotor applications. A virtual simulation approach may help address the learning gap by providing ongoing clinical training to students in situations where face-to-face is not possible. In previous studies, students described virtual simulation as engaging and motivating when compared with traditional learning and reported high levels of satisfaction and increased confidence in learned skills (Graham et al., 2018; Hanson et al., 2020; Verkuyl et al., 2017).

The literature suggested that virtual simulation can be used as a substitute for some clinical practicum hours (Fogg et al., 2020; Rutherford-Hemming et al., 2016). Clinical simulations can be supported by various levels of technology, from highly sophisticated programmed mannequins to no technological support (e.g. standardized patients). Although a recent meta-analysis concluded that higher levels of technical support are associated with higher effects on student learning outcomes, using high-fidelity simulators was not possible due to limited resources and a large number of students (Chernikova et al., 2020). Thus, the virtual simulation could eliminate the disadvantages of inadequate time, resources and opportunities to practice in clinical fields.

The implementation of virtual simulation in clinical education also measured some critical components of students' learning. These include the effect on students' learning outcomes, including knowledge and clinical competency. Several randomized control trials have measured the impact of virtual simulation on objective learning outcomes, such as knowledge acquisition, clinical reasoning and clinical skill performance in undergraduate nursing students (Gu et al., 2017; Liaw et al., 2014; Padilha et al., 2019). In these studies, students who participated in a virtual simulation had similar or better performance to students who experienced traditional face-to-face learning methods. These studies have provided some evidence that students could gain clinical competencies in both traditional and simulation environments.

However, students' learning needs using virtual simulation as a teaching pedagogy did not draw much attention to nurse educators in the past. Only a few studies implemented virtual simulation in classroom teaching and clinical curriculum. One literature showed that virtual simulations suit students' learning needs in specialties like disaster nursing, which students did not have many chances to encounter in real-life practice (Henny & Melissa, 2015). More studies would be needed to investigate how nursing students' learning needs would be met using virtual simulation.

1.2 | Debriefing

Debriefing also served as a crucial component in virtual simulation pedagogy. The debriefing process was developed from the simulation-teaching framework from Kolb's experiential learning theory (Sato & Laughlin, 2018). It provides a chance that students could reflect on what they have done and notice the strengths and improvement areas in that event (Al Sabei & Lasater, 2016). In addition to providing a means for experiential learning, the debriefing served as an instructional design that can be employed to improve communication, critical thinking, clinical competence and readiness to practice. The conceptual relationship of these educational outcomes to debriefing can be viewed as a cyclical process. The method of knowledge creation would take place through the transformation of experience using simulation. Learning not only takes place during the simulation activity, but it also occurs during reflection in a debriefing session. Each learner brings life experience to the simulation that will affect how these individuals process and employ the knowledge they gain through the experiential learning cycle. Besides self-reflecting and collecting feedback from teachers, students can also learn from their peers in the debriefing process.

Virtual simulation studies usually have no debriefing sessions or facilitated debriefing sessions after simulation activities. Very few studies included debriefing sessions in the postsimulation activity. In a recent meta-analysis, around half of the virtual simulation sessions

did not have postsimulation debriefing sessions (Shin et al., 2019). There were different types of debriefing methods, one of them was self-debriefing. Self-debriefing is usually conducted in a written form, and it was supplementary to group debriefing sessions (Verkuyl et al., 2020). A previous study also suggested that an immediate self-debrief after a virtual simulation experience to consolidate student learning was an effective approach along with a group debriefing (Verkuyl et al., 2019). However, the above studies did not consider the effectiveness to optimize the learning of nursing students when the debriefing sessions were facilitated.

To our best knowledge, none of the studies has investigated an online simulation education programme using both virtual simulation platforms with immediately facilitated debriefing together. Thus, our study sought to evaluate perceived clinical competence by incorporating a virtual simulation platform with an immediately facilitated debriefing.

1.3 | Debriefing framework

There were several debriefing frameworks in virtual simulation teaching. One of the models was “3D Model of Debriefing” (Zigmont et al., 2011). The 3D Model of Debriefing provides a structured framework for students and facilitators to share the simulation experiences. In the first D, "defusing," students are prompted to discuss their emotions and describe the events. They are facilitated to portray the content of the scenario and the difficulties they have encountered. The students then move on to "discovering." The facilitators would guide students to self-reflect and help identify students' rationale behind their actions and inform students of the rooms of improvement while reviewing their results on the simulation platform. Their peers could comment on others' performances and reflect on their own. The facilitators would then inform students of the rooms for improvements so that students could discover the learning gap between their performance and the expected performance and understand what could be done better when they encounter similar scenarios in real life. In the last D, "deepening," students are encouraged to apply and transform the new learning into practice. For instance, students could propose what they could do when they were to deal with a similar situation by using the newly acquired knowledge from their peers and facilitators. The use of the 3D Model of Debriefing following simulated clinical settings has been shown to improve clinical performance and patient care. It also provides an additional advantage of enhancing team performance which is vital in clinical settings.

In this study, we opted for using virtual simulation in combination with immediate face-to-face debriefing to provide students with a realistic clinical experience. This programme provides an authentic environment that replicated real clinical situations. It would be helpful to, particularly to the undergraduate nursing programme's final year, equip them with sufficient clinical competencies for the near future.

2 | AIMS OF THE STUDY

This study aimed to evaluate the effect of a virtual simulation education programme on undergraduate nursing students. The impact of the virtual simulation that we are evaluating is its effectiveness combined with an immediately facilitated debriefing to replace the traditional clinical practicum in the COVID-19 situation partially.

The specific objectives were.

-To examine nursing students' perceived clinical competence before and after a virtual simulation education programme; and.

-To compare how well the learning needs were met in the virtual simulation education programme comparing with the traditional clinical practicum.

The study hypothesis is that students would have better perceived clinical competence after taking part in the simulation programme.

3 | METHODS

3.1 | Design, participants and setting

This study adopted a one-group pre-test post-test design. A total of 188 final year nursing undergraduate students in a 5-yearly curriculum were enrolled in the study. All students were eligible, and no students declined to take part in the study. Twenty-four students did not complete the whole questionnaire on the second simulation day. Before the study, they processed basic and advanced nursing skills. They completed most of their clinical practicum except for the remaining ones in their final year of study, which were medical and surgical cases. Since it was their first time experiencing the virtual simulation, all students were taught in workshops about how to use the virtual simulation platform by trained facilitators in our School in the pre-briefing session. The facilitator would then send an instruction manual to them. They have received briefing information on the clinical cases before the beginning of the simulation. Then, students worked independently on the cases. The virtual simulation was designed to enhance student's clinical competence, partly by enabling the opportunity for decision-making. This was achieved by allowing students to choose the most pertinent items with minimal prompting. After that, facilitators would debrief the students in groups about their performance and decision-making skills in the scenarios. The facilitators involved in the operations and debriefing were all trained by the principal investigator to use the 3D Model of Debriefing and DxR Nursing SELECT platform in a two-day workshop. The virtual simulation was conducted in the DxR Nursing SELECT platform, and debriefing sessions were carried out on the Zoom platform. The students stayed at home to complete the programme and evaluation study online. The Transparent Reporting of Evaluation with Nonrandomised Designs Checklist (Supplementary file 1) was used in this study (Des Jarlais et al., 2004).

3.2 | Intervention

The virtual simulation education programme provided for the students was a two-day workshop. Each session consisted of a 4-hr virtual simulation session and 4-hr debriefing.

3.3 | Virtual simulation

In the time of COVID-19, nursing undergraduate students were facing an imminent threat in the opportunity to get into clinical practice. They were deficient in clinical hours and we had to find ways to replace the hours. Virtual simulation is seemingly an optimal solution as it has no spatial and time barrier for students to work on the scenarios. Constructive alignment was performed to ensure that the learning objectives of the teaching and learning activity matched the intended learning objectives of the clinical practicum. The online virtual simulation platform, DxR Nursing SELECT was used. The clinical competencies were aimed to enhance clinical competence by prioritizing and selecting the most pertinent items relating to the simulated patient in domains of chart assessment, physical assessment, nursing diagnosis, nursing intervention, evaluation and clinical judgements. Four cases related to the management of medical and surgical patients were chosen to provide authentic clinical simulation training and sufficient clinical hours. In each of the simulation session, students were required to finish four clinical cases in two hours. The students had to identify the items that are pertinent to the nursing care of the client within each learning module. They are namely chart assessment, physical assessment, nursing diagnosis, intervention and evaluation. Each student had to select the items most pertinent that urgently relate to the case throughout each learning module and are thereby required to make a clinical assessment and decision-making. During the simulation, students would not have received any support from facilitators. After the simulation, students would receive feedback from the DxR system. The system will generate a raw score of what pertinent items were chosen correctly. Facilitators would also facilitate students by the use of a 3D debriefing model as shown below. Table 1 provides the descriptions of the four case scenarios.

3.4 | Debriefing

Debriefing is critical to the success of simulation-based education. (Bradley et al., 2020). The debriefing process was intended to reveal the students' experiences, performance and issues encountered during the simulation. Immediate guided debriefing was essential for students to understand their performances. Thus, we opted to offer immediate post-simulation guided debriefing to students. The facilitators were given guidelines to use the 3D model to guide students to explore their mental models on their simulation experience. The facilitated debriefing helped identify the rationale behind their actions and, most importantly, suggest students improve for future clinical practice by reviewing their results simulation platform. The debriefing process had provided the additional benefit of students learning from their own and peers' experiences, thus enhancing clinical competencies. Each group of students was a study unit of process evaluation, where all the data inputs and outcomes were monitored by research staff for further analysis (Moore et al., 2015). Spot checks were conducted in every group by an investigator to ensure consistent delivery of the intervention proposed (fidelity check). After each session, the investigator will review the recorded debriefing sessions and debrief the facilitators to ensure the intervention consistently meets the outcomes.

3.5 | Measurements

Perceived clinical competence. The Clinical Competence Questionnaire (CCQ) [(Liou & Cheng, 2013)] with 47-item was used. It measured the perceived clinical competence of nursing students. It contains four main competency components: nursing professional behaviours (16 items, scores range from 16–90), general performance (13 items, scores range from 13–65), core nursing skills (12

TABLE 1 Description of the case scenarios (Medical and Surgical cases)

Virtual simulation day	Case scenario	Description
Day 1	Case 1 (Assisted living facility)	A female client, diagnosed with pneumonia has just been released after a two-week stay at an acute care hospital and is being assessed for re-admission to the assisted living facility
	Case 2 (Stroke/Alzheimer's)	A male client with Alzheimer's disease is admitted after presenting earlier in the day to the Emergency Unit with the chief complaint of left-sided weakness. He is diagnosed with a stroke in the right anterior and middle cerebral artery
Day 2	Case 3 (Fractured femur)	A female client with diabetes and a left above-the-knee amputation and partial amputation of the right foot is admitted to the hospital via the Emergency Unit after falling from her wheelchair two days earlier. She is diagnosed with a fractured femur and scheduled for open reduction and internal fixation surgery. During her stay, she discusses physical and emotional issues with the nurse
	Case 4 (Adult pneumonia)	A female client has been admitted to the hospital's medical unit with a 'painful' cough, high fever, chest pain and rapid and laboured respirations. She is diagnosed with pneumonia

items, scores range from 12–60) and advanced nursing skills (6 items, scores range from 6–30). All items were measured with a 5-point Likert scale (1 = have no idea to 5 = know, in theory, indicating competence in practice without supervision). The total score ranges from 47–235. A higher score shows higher perceived competence. The Cronbach's alphas for the entire CCQ and subscales were between 0.90 and 0.98 (Gu et al., 2018). In this study, the Cronbach's alphas for the entire CCQ and subscales were between 0.88 and 0.97. The reliability of all subscales in CCQ was shown in Table 2.

3.6 | Learning needs

The Clinical Learning Environment Comparison Survey (CLECS) [(Gu et al., 2018)] assessed students' overall perceptions of traditional clinical and simulation settings to understand the perceived similarities and differences between the two settings. Students rated their experiences respectively in traditional clinical practicum done in their 4th year of study and working on scenarios in virtual simulation platform side-by-side on 29 items related to clinical learning experiences (Leighton, 2015). The instrument provides a total score and six subscale scores, including self-efficacy (four items), teaching-learning dyad (five items), holism (six items), communication (four items), nursing process (six items) and critical thinking (two items). Each subscale has a rating for the traditional clinical environment and the simulation environment. The reported Cronbach's alphas of the subscales in the traditional clinical environment ranged from 0.741 to 0.877, and those in the simulation environment ranged from 0.826 to 0.913 (Leighton, 2015). In this study, the Cronbach's alphas for the subscales in the traditional clinical environment ranged from 0.80 to 0.93 and those in the simulation environment ranged from 0.86 to 0.92. The construct validity of all subscales in CLECS in earlier studies was shown in Table 3.

TABLE 2 Reliability of CCQ in previous studies

	Subscale	Cronbach's Alpha
CCQ	Nursing professional behaviours	0.95
	Skills related competencies	0.97

3.7 | Student satisfaction

The overall student satisfaction was measured with a 7-point Likert scale at the end of each simulation session (1 = not satisfied at all to 7 = extremely satisfied).

3.8 | Demographics

We collected data including age, gender, temporary undergraduate nursing students (TUNS) and their year of clinical experience as part-time nursing students working in public hospitals. The exposure duration in this part-time job is expected to affect the students' perceived clinical competence.

3.9 | Procedures and data collection

The study was reviewed and approved by the local ethics board. Written consent was obtained from the students, who then completed the baseline questionnaire, which included demographic questions and the CCQ.

Two whole-day (16 hr) virtual simulations were provided for the entire class. The first day was held in March 2020, and the second day was held after a week from the first day. On each simulation day, a pre-briefing would be held to familiarize students about the cases before the simulation began. The students were allowed and required to have four hours to complete two case scenarios. In the debriefing session, participants were divided into 30 groups. A facilitator would be assigned to a group with 6–7 students. They would supervise students in both virtual simulation activity and debriefing session. The timeline of the debriefing session is shown in Table 4.

TABLE 3 Reliability of CLECS in previous studies

CLECS	Subscale	Cronbach's Alpha
Traditional Clinical Environment	Self-efficacy	0.831
	Teaching-Learning Dyad	0.820
	Holism	0.901
	Nursing Process	0.847
	Critical Thinking	0.881
	Communication	0.726
Simulated Clinical Environment	Self-efficacy	0.857
	Teaching-Learning Dyad	0.859
	Holism	0.935
	Nursing Process	0.865
	Critical Thinking	0.819

TABLE 4 Debriefing process and content for each simulation case

Duration: 2 hr for "each case"	Debriefing process
1st hour	• Introduce the cases • Pre-briefing • Discuss emotions and recap events that happened in the case
2nd hour	• Prompt reflections on the cases and themselves while playing the video • Discover mental model in handling the cases • Applying novel information gained into future practice

A post-test questionnaire, including the CCQ, CLECS and overall student satisfaction, was administered at the end of each of the simulation days. They are named as post 1 and post 2 tests indicating the data collected in post-simulation Day 1 and post-simulation Day 2.

3.10 | Data analysis

The analyses were conducted using SPSS version 21. The CCQ, CLECS and overall satisfaction were normally distributed. The paired samples *t* test was be applied to further analyse the difference between baseline and Post 1/Post 2. The mean and standard deviation was used to describe the variables in CCQ, CLECS and overall satisfaction. Linear mixed model analysis was conducted to evaluate differences in the studied variables over time (baseline, post-simulation Day 1 [Post 1] and pos-tsimulation Day 2 [Post 2]). Random effects for participants with an assumed compound symmetry structure and restricted maximum likelihood estimation were included in the model. The TUNS (temporary undergraduate nursing students) experience was adjusted in the model. The paired samples *t* test was be applied to further analyse the difference between baseline and Post 1/Post 2. The incompleted twenty-four questionnaires were treated as missing data. They were imputed by using the last observation carried forward, and a complete case analysis was conducted as the sensitivity analysis. *p*-values of less than .05 were considered statistically significant.

4 | RESULTS

4.1 | Characteristics of study participants

A total of 188 students participated in the study, including 54 (28.7%) males and 134 (71.3%) females. There were 175 (93.1%) students who reported TUNS experience, and 167 (88.8%) had attended virtual simulation training before participating in the study (Table 4). There were 24 students who did not complete the whole questionnaire on the second simulation day. The attrition rate is 12.8%. There were significant differences regarding gender ($\chi^2 = 6.08$, $p = .01$) and attended virtual simulation training before ($\chi^2 = 5.30$, $p = .02$) at the baseline between the students who participated in both simulation days and those who dropped out on the 2nd day. There was no difference in CCQ ($t = -1.04$, $p = .30$) and TUNS experience($\chi^2 = 0.09$, $p = .77$). Other demographics are shown in Table 5.

TABLE 5 Demographics of study participants

	Number ($N = 188$)	%
Sex		
Male	54	28.7%
Female	134	71.3%
TUNS experience		
Yes	175	93.1%
No	13	6.9%
Had previously attended virtual simulation training		
Yes	167	88.8%
No	21	11.2%

The description of the mean (*SD*) on each subscale, total CCQ score and the results of the paired *t* test are shown in Table 6.

After replacing the missing values by using the last observation carried forward, the linear mixed model indicated a significant time effect on the total CCQ score ($F = 72.92$, $p = .00$) and its subscales: nursing professional behaviours ($F = 47.32$, $p = .00$), core nursing skills ($F = 89.25$, $p = .00$), general performance ($F = 16.44$, $p = .00$) and advanced nursing skills ($F = 113.30$, $p = .00$). The sensitivity analyses for the complete cases indicated there was a significant time effect on the total CCQ score and these subscales.

Paired *t* tests revealed significant increases in the total CCQ score and its subscales from baseline to Post 1 and from baseline to Post 2. The score ranges from 1 (do not have a clue) to 5 (known in theory, competent in practice without supervision). The results are shown in Table 6.

4.2 | Learning needs

Table 7 showed that scores in communication ($t = 11.25$, $p < .05$) and critical thinking ($t = 3.24$, $p < .05$) were significantly lower in the simulated environment but significantly higher in the nursing process ($t = -2.69$, $p < .05$), compared with the traditional environment. At Post 2, the scores in communication ($t = 6.88$, $p < .05$) and critical thinking ($t = 2.07$, $p < .05$) were significantly lower in the simulated environment but significantly higher in the nursing process ($t = -2.54$, $p < .05$), compared with the traditional environment.

TABLE 6 Description of CCQ and results of the paired *t* test

Variables	Mean (SD)			Paired *t* test			
	Baseline	Post 1 (Simulation day 1)	Post 2 (Simulation day 2)	Baseline to Post 1(Simulation day 1) (t)	*p*-value	Baseline to Post 2 (Simulation day 2) (t)	*p*-value
Nursing professional behaviours (16 items) Core	62.8(8.1)	67.6 (7.5)	67.1(7.8)	−8.78*	.00	−7.01*	.00
nursing skills (12 items) General	49.5(6.9)	54.6(6.1)	54.2(6.1)	−11.93*	.00	−9.86*	.00
performance (12 items) Advanced	48.3(6.9)	50.5(6.7)	50.2 (6.6)	5.36*	.00	−4.02*	.00
nursing skills (6 items)	20.0(3.9)	22.6(3.7)	23.1(3.5)	−11.13*	.00	−12.52*	.00
Total score	188(23.5)	195.3(21.7)	194.6(22.2)	−10.57*	.00	−9.01*	.00

$^{*}p < .05$

4.3 | Overall satisfactions

Students reported 5.3 (*SD*, 0.9) average satisfaction at Post 1 and 5.4 (*SD*, 0.9) at Post 2.

5 | DISCUSSION

This was the first nursing virtual simulation study in the Hong Kong population that incorporated a debriefing approach in an experiential online learning programme. It was a ground-breaking and innovative study that investigated the self-report of perceived clinical competence by nursing students through a virtual simulation education programme that followed immediately with a guided debriefing by a facilitator. The study examined how students perceived themselves in several clinical competency domains. Also, students' self-reported comparison between simulated and traditional clinical environment were measured. The results revealed that students recognized they had improvements in clinical aspects, and their learning in some components was better or similar to the traditional clinical environment.

5.1 | Perceived improvements in clinical competencies

Nursing students perceived that they had significant improvements in clinical competencies after attending the online virtual simulation programme. Our findings revealed comparable results to other studies in terms of the perceived clinical competencies investigated through the virtual simulation (Kiernan, 2018; Raman et al., 2019). The cases selected were all-rounded medical and surgical cases. It could train students' prioritization in nursing diagnosis, intervention and clinical judgement. Furthermore, it enabled students to manage the clinical issues raised in a valid representation of clinical practice through the virtual simulation programme. Post-simulation debriefing sessions were held immediately after each virtual simulation activity which facilitated students to handle similar clinical issues in real practice. Students had the opportunities to review their knowledge and emotions during the virtual simulation in the debriefing session. In this study, the overall perceived competence across all domains increased significantly ($p < .00$). The 3D debriefing model facilitated an inquiry-based debriefing process that enabled students to deepen and ventilate their thoughts in making clinical decisions. Group debriefing enabled a collaborative learning environment to learn from peers in understanding conceptual knowledge and chairside clinical problem-solving. In future practice, nursing educators could adopt the debriefing model in their teaching curriculum. Students could then transfer and assimilate their learning in simulation to work behaviours (Cant & Cooper, 2011). The debriefing session indeed was an integral part of the virtual simulation programme which consolidated students' clinical knowledge and experience in a virtual simulation. Although 24

TABLE 7 Description of CLECS and results of the simulation day 1 and simulation day 2 paired *t* tests

Variable			Mean (*SD*)	t	*p*-value
Post 1	Communication, *N* = 181	Traditional	12.1(2.1)	11.25*	.00
		Simulated	9.6(3.1)		
	Nursing process, *N* = 182	Traditional	17.7(3.3)	−2.69*	.01
		Simulated	18.4(3.4)		
	Holism, *N* = 181	Traditional	16.9(3.9)	1.48	.14
		Simulated	16.5(4.3)		
	Critical thinking, *N* = 181	Traditional	6.0(1.2)	3.24*	.001
		Simulated	5.7 (1.4)		
	Self-efficacy, *N* = 181	Traditional	11.3 (2.4)	−1.32	.19
		Simulated	11.5(2.4)		
	Teaching-learning dyad, *N* = 182	Traditional	15.3(2.7)	−0.44	.66
		Simulated	15.4(3.0)		
Post 2	Communication, *N* = 157	Traditional	12.2 (2.4)	6.88*	.00
		Simulated	10.6(2.8)		
	Nursing process, *N* = 158	Traditional	17.9(3.4)	−2.54*	.01
		Simulated	18.5(3.5)		
	Holism, *N* = 158	Traditional	17.3(3.7)	0.59	.56
		Simulated	17.1(4.2)		
	Critical thinking, *N* = 157	Traditional	6.1(1.2)	2.07*	.04
		Simulated	5.9(1.3)		
	Self-efficacy, *N* = 157	Traditional	11.7(2.4)	−0.36	.72
		Simulated	11.8(2.6)		
	Teaching-learning dyad, *N* = 158	Traditional	15.3(2.8)	−1.20	.23
		Simulated	15.6(3.0)		

*$p < .05$

students did not complete the whole questionnaire in simulation day two, they had no decline in perceived clinical competence. The above result implied that virtual simulation sessions could be flexible. Nursing educators could design the virtual simulation programme based on the time allowed and students' progress. This pedagogy suggested the emergence of an alternative clinical training modality related to exploring content or knowledge processes and potentially comparable to traditional clinical practice based on students' perception of their clinical competence.

5.2 | Perceived learning needs comparison between learning environments

Contrasting results were shown in comparing the learning needs between simulated and traditional clinical environments. Students reported that learning in both environments boosts self-efficacy. They were consistent with the findings of other similar studies (Bambini et al., 2009). This is an ideal environment as students' perceptions towards themselves do not change even the learning environment has changed. The study also revealed that the teaching-learning dyad was also similar in both environments. Thus, the simulated environment did not affect the collaborative relationship between teachers and students although all the learning processes have been moved to an online and simulated platform.

Students also reported that they could learn the nursing process better ($t = -2.69$, $p < .05$) in a simulated environment than the traditional clinical environment. The learning styles of Chinese students could account for this phenomenon. One study found that Chinese students focused on assessment contents or what they thought would be assessed in tests and examinations and associated learning effect known as the "washback" effect (Tiwari & Tang, 2003). The 3D model provided a strong basis for students to apply what they had learnt, which strongly suited Chinese students' learning styles. Therefore, students found that the virtual simulation education programme met their learning needs, as it served the purpose of consolidating their prioritization of nursing diagnosis and receiving immediate feedback on performance.

On contrary, students revealed that learning in a virtual simulation platform had profoundly lacked communication and critical thinking elements compared with the traditional environment. These elements were also essential in nursing practice. The user interface in the platform only allowed students to select the most pertinent relating to the virtual patients. No direct communication was needed with patients or other health professionals. For critical thinking, more differences were shown between the two environments in

the 1st simulation day while less in the 2nd simulation day. This was a contrasting result comparing with other studies. Students might not easily recognize the clinical problems and interpret the data in cases when compared with the traditional clinical environment (Fero et al., 2010). Thus, the application of critical thinking skills may be different from an authentic ward setting.

5.3 | Evaluation of the online virtual simulation education programme

The ongoing COVID-19 situation promoted difficult times to clinical education in nursing. But this has provided nursing educators opportunities to develop innovative pedagogies. The results from the CLECS indicated that the programme was successful. Students have rated themselves performing better in clinical competencies with a combination of a virtual simulation platform and immediate post-simulation debriefing session within the education programme. Also, no significant differences were found in the teaching-learning dyad, self-satisfaction and self-confidence when learning in the virtual and traditional clinical environment. Thus, students believed they were able to learn well and cooperate with instructors in both environments, not only in the traditional clinical environment. This online virtual simulation programme can effectively replace some of the lost clinical hours and students can learn without time and space constraints since the programme is entirely online.

6 | LIMITATION

Since we have adopted a one-group pre-test post-test design in the study, a major limitation is the lack of a control group to compare the results. Future studies should include a control group to have a comparison between the groups. Another limitation of the study is the lack of long-term measurement of the learning process. There is a lack of follow-up measurement of students' learning process after the programme ended for a while. Future studies should consider follow-up measures to look at the persistence of simulation education programmes. Assessor measured clinical competencies could also be adopted in future studies to objectively measure nursing students' clinical competencies. For instance, the Competency Evaluation Instrument (CCEI) can be used for assessors to access core clinical competencies of nursing students in simulation (Hayden et al., 2014).

6.1 | Implications to clinical education and future research

Clinical practicum is crucial for nursing students for their licensure and future practice. The study provided an innovative clinical learning pedagogy to serve as an alternative clinical modality during the COVID-19 period and in the new normal as traditional clinical practicum is substantially limited. In the future, it is suggested to replicate the study in next year for comparing the learning outcomes after COVID-19 pandemic to get a comprehensive picture of the effect of virtual simulation.

7 | CONCLUSION

This is the first study investigating the use of virtual simulation to teach undergraduate nursing students in Hong Kong. This study successfully demonstrated that the virtual simulation education programme can provide opportunities for students to further enhance nursing decisions, perceived competence, learning needs and acquired knowledge without the boundaries of time and space. This pedagogy suggested the emergence of an alternative clinical training modality related to exploring content or knowledge processes and potentially comparable to traditional clinical practice based on students' perception of their clinical competence. This modality has been used primarily in the COVID-19 pandemic as a novel teaching pedagogy in the undergraduate nursing curriculum. The findings of this study support the ongoing measurement of undergraduate nursing students' self-report of perceived clinical competence.

ACKNOWLEDGEMENT

School of Nursing, LKS Faculty of Medicine, The University of Hong Kong

CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTIONS

Fung Tai Chun John: Conceptualization, Methodology, formal analysis, writing – original draft, review and editing. Zhang Wen: formal analysis; writing – review and editing. Pang Tsz Ha, Michelle: Conceptualization. Lam Suk Fun, Veronica: Conceptualization, Methodology. Chan Kai Yin, Bobo: formal analysis, writing – original draft; writing – review and editing. Wong Yuen Ha, Janet: Methodology, writing – review and editing.

ETHICS APPROVAL

The study was reviewed and approved by the HKU/HA HKW Institutional Review Board (UW-20–382).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

John Tai Chun Fung https://orcid.org/0000-0002-5237-056X
Wen Zhang https://orcid.org/0000-0002-8166-2879
Veronica Suk Fun Lam https://orcid.org/0000-0003-3612-1851
Bobo Kai Yin Chan https://orcid.org/0000-0002-6128-3871
Janet Yuen-Ha Wong https://orcid.org/0000-0002-3000-4577

REFERENCES

Al Sabei, S. D., & Lasater, K. (2016). Simulation debriefing for clinical judgment development: A concept analysis. *Nurse Education Today*, *45*, 42–47. https://doi.org/10.1016/j.nedt.2016.06.008

Bambini, D., Washburn, J., & Perkins, R. (2009). Outcomes of clinical simulation for novice nursing students: Communication, confidence, clinical judgment. *Nursing Education Perspectives*, *30*, 79–82.

Bradley, C. S., Johnson, B. K., & Dreifuerst, K. T. (2020). Debriefing: A place for enthusiastic teaching and learning at a distance. *Clinical Simulation in Nursing*, *49*, 16–18. https://doi.org/10.1016/j.ecns.2020.04.001

Cant, P., & Cooper, J. (2011). The benefits of debriefing as formative feedback in nurse education. *Australian Journal of Advanced Nursing*, *29*(1), 37–47.

Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T., & Fischer, F. (2020). Simulation-based learning in higher education: A meta-analysis. *Review of Educational Research*, *90*, 499–541. https://doi.org/10.3102/0034654320933544

Department of Health HK (2020). *Coronavirus Disease (COVID-19) in HK*. https://www.coronavirus.gov.hk/eng/index.html. Accessed 25 January 2021.

Des Jarlais, D. C., Lyles, C., & Crepaz, N. (2004). Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: The TREND statement. *American Journal of Public Health*, *94*, 361–366. https://doi.org/10.2105/AJPH.94.3.361

Fero, L. J., O'Donnell, J. M., Zullo, T. G., Dabbs, A. D., Kitutu, J., Samosky, J. T., & Hoffman, L. A. (2010). Critical thinking skills in nursing students: Comparison of simulation-based performance with metrics. *Journal of Advanced Nursing*, *66*, 2182–2193. https://doi.org/10.1111/j.1365-2648.2010.05385.x

Fogg, N., Kubin, L., Wilson, C. E., & Trinka, M. (2020). Using virtual simulation to develop clinical judgment in undergraduate nursing students. *Clinical Simulation in Nursing*, *48*, 55–58. https://doi.org/10.1016/j.ecns.2020.08.010

Graham, C. L., Atz, T., Phillips, S., Newman, S., & Foronda, C. (2018). Exploration of a racially diverse sample of nursing students' satisfaction, self-efficacy, and perceptions of simulation using racially diverse manikins: a mixed methods pilot study. *Clinical Simulation in Nursing*, *15*, 19–26. https://doi.org/10.1016/j.ecns.2017.08.007

Gu, Y.-H., Xiong, L., Bai, J.-B., Hu, J., & Tan, X.-D. (2018). Chinese version of the clinical learning environment comparison survey: Assessment of reliability and validity. *Nurse Education Today*, *71*, 121–128. https://doi.org/10.1016/j.nedt.2018.09.026

Gu, Y., Zou, Z., & Chen, X. (2017). The effects of vSIM for nursing™ as a teaching strategy on fundamentals of nursing education in undergraduates. *Clinical Simulation in Nursing*, *13*, 194–197. https://doi.org/10.1016/j.ecns.2017.01.005

Hanson, J., Andersen, P., & Dunn, P. K. (2020). The effects of a virtual learning environment compared with an individual handheld device on pharmacology knowledge acquisition, satisfaction and comfort ratings. *Nurse Education Today*, *92*, 104518. https://doi.org/10.1016/j.nedt.2020.104518

Hayden, J., Keegan, M., Kardong-Edgren, S., & Smiley, R. A. (2014). Reliability and validity testing of the creighton competency evaluation instrument for use in the NCSBN national simulation study. *Nurs Educ Perspect*, *35*, 244–252. https://doi.org/10.5480/13-1130.1

Henny, B., & Melissa, J. (2015). Experiential learning: using virtual simulation in an online RN-to-BSN program. *The Journal of Continuing Education in Nursing*, *46*, 27–33. https://doi.org/10.3928/00220124-20141120-02

Kiernan, L. C. (2018). Evaluating competence and confidence using simulation technology. *Nursing*, *48*, 45–52. https://doi.org/10.1097/01.NURSE.0000545022.36908.f3

Leighton, K. (2015). Development of the clinical learning environment comparison survey. *Clinical Simulation in Nursing*, *11*, 44–51. https://doi.org/10.1016/j.ecns.2014.11.002

Liaw, S. Y., Chan, S.- W.-C., Chen, F.-G., Hooi, S. C., & Siau, C. (2014). Comparison of virtual patient simulation with mannequin-based simulation for improving clinical performances in assessing and managing clinical deterioration: Randomized controlled trial. *Journal of Medical Internet Research*, *16*, e214. https://doi.org/10.2196/jmir.3322

Liou, S.-R., & Cheng, C.-Y. (2013). Developing and validating the clinical competence questionnaire: A self-assessment instrument for upcoming baccalaureate nursing graduates. *Journal of Nursing Education and Practice*, *4*(2), 56–66. https://doi.org/10.5430/jnep.v4n2p56

Moore, G. F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., Moore, L., O'Cathain, A., Tinati, T., Wight, D., & Baird, J. (2015). Process evaluation of complex interventions: Medical research council guidance. *BMJ: British medical journal / British Medical Association*, *350*, h1258. https://doi.org/10.1136/bmj.h1258

Padilha, J. M., Machado, P. P., Ribeiro, A., Ramos, J., & Costa, P. (2019). Clinical virtual simulation in nursing education: randomized controlled trial. *Journal of Medical Internet Research*, *21*, e11529.

Raman, S., Labrague, L. J., Arulappan, J., Natarajan, J., Amirtharaj, A., & Jacob, D. (2019). Traditional clinical training combined with high-fidelity simulation-based activities improves clinical competency and knowledge among nursing students on a maternity nursing course. *Nursing Forum*, *54*, 434–440. https://doi.org/10.1111/nuf.12351

Rutherford-Hemming, T., Nye, C., & Coram, C. (2016). Using simulation for clinical practice hours in nurse practitioner education in the United States: A systematic review. *Nurse Education Today*, *37*, 128–135. https://doi.org/10.1016/j.nedt.2015.11.006

Sato, T., & Laughlin, D. D. (2018). Integrating Kolb's experiential learning theory into a sport psychology classroom using a golf-putting activity. *Journal of Sport Psychology in Action*, *9*, 51–62. https://doi.org/10.1080/21520704.2017.1325807

Shin, H., Rim, D., Kim, H., Park, S., & Shon, S. (2019). Educational characteristics of virtual simulation in nursing: An integrative review. *Clinical Simulation in Nursing*, *37*, 18–28. https://doi.org/10.1016/j.ecns.2019.08.002

Tiwari, A., & Tang, C. (2003). From process to outcome: The effect of portfolio assessment on student learning. *Nurse Education Today*, *23*, 269–277. https://doi.org/10.1016/S0260-6917(03)00012-1

Verkuyl, M., Hughes, M., Atack, L., McCulloch, T., Lapum, J. L., Romaniuk, D., & St-Amant, O. (2019). Comparison of self-debriefing alone or in combination with group debrief. *Clinical Simulation in Nursing*, *37*, 32–39. https://doi.org/10.1016/j.ecns.2019.08.005

Verkuyl, M., Hughes, M., Tsui, J., Betts, L., St-Amant, O., & Lapum, J. L. (2017). Virtual gaming simulation in nursing education: A focus group study. *Journal of Nursing Education*, *56*, 274–280. https://doi.org/10.3928/01484834-20170421-04

Verkuyl, M., St-Amant, O., Hughes, M., Lapum, J. L., & McCulloch, T. (2020). Combining self-debriefing and group debriefing in simulation. *Clinical Simulation in Nursing*, *39*, 41–44. https://doi.org/10.1016/j.ecns.2019.11.001

Zigmont, J. J., Kappus, L. J., & Sudikoff, S. N. (2011). The 3D model of debriefing: Defusing, discovering, and deepening. *Seminars in Perinatology*, *35*, 52–58. https://doi.org/10.1053/j.semperi.2011.01.003

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Fung, J. T. C., Zhang, W., Yeung, M. N., Pang, M. T. H., Lam, V. S. F., Chan, B. K. Y., & Wong, J. Y.-H. (2021). Evaluation of students' perceived clinical competence and learning needs following an online virtual simulation education programme with debriefing during the COVID-19 pandemic. *Nursing Open*, 8, 3045–3054. https://doi.org/10.1002/nop2.1017