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Title:

Nursing students' learning dynamics and perception of high-fidelity simulation-based learning

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Abstract

Background:

Nursing students' high-fidelity simulation-based learning (HF-SBL) dynamics remain poorly understood. This study aimed to construct a substantive theory of nursing students' HF-SBL dynamics by exploring nursing students' experiences of HF-SBL and identifying factors that influence HF-SBL.

Method:

Constructivist grounded theory was adopted. Twenty-three semi-structured interviews with memo writing were conducted with 16 undergraduate nursing students. All collected data were managed using NVivo 11.

Findings:

This study constructed a theoretical model of HF-SBL dynamics, consisting of process and four influencing factors of HF-SBL. Moreover, the students' perception on a lack of psychological fidelity during HF-SBL was identified and highlighted.

Conclusion:

Through understanding of the model, nursing educators can improve their current simulation-based education and make it more relevant and realistic for students.

Introduction

Simulation-based learning (SBL) has increasingly been integrated into the education and training of healthcare professionals and students (Ryall, Judd, & Gordon, 2016). It has become a core part of nursing education curricula in many countries e.g. Australia (Nash & Harvey, 2017), South Korea (Kim & Kim, 2017) and the United States (Miles, 2018). SBL provides opportunities for nursing students to have direct and repeated experiences of nursing practice in a safe and supportive environment, where the students can learn from their mistakes and gain support from their peers and lecturers (Cant & Cooper, 2017; Jacobs & Venter, 2017; Ramm, Thomson, & Jackson, 2015).

First used in nursing education in 1911, technological developments have resulted in an evolution of the educational use of SBL (NLN, 2015; Ryall et al., 2016). The level of fidelity of SBL indicates "*the ability of the simulation to reproduce the reactions, interactions, and responses of the real world counterpart*" (i.e., level of realism) (Lopreiato et al., 2016, p. 11). A higher fidelity of the simulation offers a higher level of 'realism' and the surrounding environment (Butler, Veltre, & Brady, 2009).

The benefits of high-fidelity SBL (HF-SBL) for nursing education include: high satisfaction with HF-SBL by students (La Cerra et al., 2019); significantly increased knowledge (Konieczny, 2016); improved quality of patient care as a result of helping students develop critical thinking abilities in clinical situations and mitigating concerns about patient safety by using simulators to replace real patients (Doolen et al., 2016; NLN, 2015); and strengthened students' nursing capabilities through the application of learnt skills before experiencing real clinical settings (Tutticci, Ryan, Coyer, & Lewis, 2018; Vincent, Sheriff, & Mellott, 2015).

Nursing education in South Korea has increasingly utilised HF-SBL to address the discrepancy between increased numbers of students and the limited availability of clinical placements (Korean Accreditation Board of Nursing Education, 2016). Although nursing students in Korea are required to complete at least 1,000 hours of clinical practice during their undergraduate courses, it is difficult for universities to find sufficient clinical placements for their students (Lee, Clarke, & Carson, 2018a). Consequently, the Korean Accreditation Board of Nursing Education allowed HF-SBL to be used for up to 10% of clinical practice time (i.e., 100 hours). This has been recently revised, with up to 12% of clinical practice time now able to be substituted by HF-SBL (Korean Accreditation Board of Nursing Education, 2018) and this has driven further adoption of HF-SBL in universities in South Korea.

The increasing use of HF-SBL in nursing education, has led to an increasing number of studies on the subject (Doolen et al., 2016), which focus on the effectiveness of HF-SBL in nursing education (Shin, Park, & Kim, 2015), such as the evaluation of pre- and post-

simulation learning outcomes (Roh, Lim, & Barry Issenberg, 2016), or comparisons of students' learning in simulations and clinical placements (Brien, Charette, & Goudreau, 2017). Systematic reviews of HF-SBL report equivocal effectiveness (Cant & Cooper, 2017). Cant and Cooper (2017) highlight the need for high quality studies. Moreover, there is a lack of research on nursing students' experiences and their learning in the context of HF-SBL – these are critical issues in having in-depth understanding of the contribution of HF-SBL to nursing education. Consequently, this study aimed to construct a substantive theory of nursing students' HF-SBL dynamics by 1) exploring nursing students' experiences and perceptions of HF-SBL and 2) identifying factors that influence students' learning dynamics in South Korea.

Methods

Grounded theory is a methodology for exploring the dynamics of concepts and uses an inductive approach to analyse data collected from participants, expressing the findings through construction of a theory (Creswell, 2018; Glaser, Strauss, & Strutzel, 1968). One form of grounded theory is constructivist grounded theory (CGT), which takes the epistemological viewpoint of constructivism. CGT stresses the need for a co-construction process between participants and researchers to explore the concepts, and consideration of contextual influences (Charmaz, 2014). This study uses CGT as its methodology to explore the dynamics of nursing students' use of HF-SBL based on their experiences in the South Korean context.

Participants

Using purposeful sampling, including theoretical sampling (Charmaz, 2014), nursing students were recruited from four different universities in Seoul, South Korea. The sample inclusion criteria were: 1) enrolment as a student in the final year of an undergraduate nursing course (which last four years in Korea), 2) previous experience of HF-SBL in an adult nursing programme during one academic semester or more (40 hours or above), and 3) experience of clinical placements during one academic semester or more. The sample exclusion criteria were: 1) students who were registered nurses studying for an undergraduate degree, or 2) had overseas experience of nursing undergraduate education.

Twenty-six students were invited to participate, of whom 16 students consented to participate in the research (a response rate of 62%). The participants were between 21 and 27 years old with a mean age of 21.88 years (SD = 1.63). Fourteen participants were female and two were male.

Data collection

Data was collected by multiple rounds of interviews using an interview guide with three parts: opening, intermediate and ending questions (Charmaz, 2014). The questions were open-ended, semi-structured and non-judgemental e.g. 'Tell me about your experience of simulation learning,' 'What was your role during the HF-SBL?' and 'How do you feel about the HF-SBL learning environment?'. All interviews were conducted by the first author to ensure consistency.

Participants were invited to up to four rounds of interviews. The interview schedule of later rounds were able to explore more in-depth issues that were identified as significant from preceding interviews, reflecting the theoretical sampling of concepts in data collection (Charmaz, 2014). In total, 23 interviews were carried out. Memos were also used during and after interviews to ensure reflexivity, which plays a vital role in CGT (Charmaz, 2014). All interviews were recorded using a voice recorder with each participant's consent. The interviews lasted for approximately 90 minutes each and were held in a public place such as a meeting or lecture rooms located in the universities.

Data analysis

Each interview recording was transcribed verbatim and then coded using NVivo 11, following the guidelines suggested by Charmaz (2014) which specify three coding stages: initial, focused and theoretical coding. Firstly, initial coding was applied to capture the characteristics of the transcripts via line-by-line and in-vivo coding. Secondly, key categories were constructed from the initial codes through focused coding. Thirdly, the analytic stage of theoretical coding sought to recognise and connect the relationships (or dynamics) between categories (Charmaz, 2014). The three stages were not followed sequentially, but followed a back-and-forth process involving constant comparison (i.e., the interview data, memos, codes, and categories were repetitively compared and analysed). The comparison continued until data saturation was reached (with no further codes and connections being identified). The third analytic stage concluded with the development of the theoretical model of HF-SBL (see Fig. 1 in Finding part).

The codes generated from each transcript were member-checked with each participant to facilitate the co-construction of meanings with the participants, as highlighted in CGT (Charmaz, 2014).

After analysis, so that the results could be reported, the interview quotes were translated by a group of five bilingual Koreans using a translation and back-translation process to prevent the loss of semantic meanings.

Reflexivity

Charmaz (2014) stressed that reflexivity in CGT is a co-constructive process between participants and researchers. The first author has an in-depth understanding of Korean nursing education and its context, and also has experience of Korean nursing education, including HF-SBL, as a both a student (4 years) and an educator (10 years). This ensured that there was a personal and theoretical sensitivity to the issues raised by participants, but may have also resulted in a reduced ability to notice aspects that were congruent with cultural expectations. These were issues that were discussed among all authors to ensure that the personal and theoretical sensitivity were optimally beneficial to data collection and analysis. All authors have experience in the analysis of qualitative interview data using the constructivist epistemology.

Rigour

Charmaz (2014) suggested four criteria for ensuring rigour in qualitative research:

- Credibility – this research adopted the strategies of member-checking, a rigorous translation process and constant comparison of the research data during data analysis in order to enhance credibility.
- Originality – the originality of the findings was assessed through a detailed examination of the existing literature after completing the analysis of interview data.
- Resonance – the interviews were continued until theoretical saturation was achieved to ensure that the authors fully comprehended students' HF-SBL experiences and word meanings were clarified.
- Usefulness – the findings of the present study could help to improve nursing students' HF-SBL experiences.

Ethical considerations

Ethical approval for this research was given by the School of Health in Social Science Ethics Committee at the University of XXXXX. The participants were informed of the purpose of this study, confidentiality of the interview data, the risks and benefits of their participation, and their right to refuse or withdraw. Once they agreed to voluntarily participate in this study, a signed written informed consent form was obtained from each participant. All person-identifiable features have been removed in the following reporting of the research findings.

<u>**Findings**</u>

Through the methodological benefit of CGT, this research developed a theoretical model of HF-SBL dynamics (see Fig. 1)

Fig. 1. A theoretical model of High-Fidelity Simulation-Based Learning Dynamics (HF-SBL Dynamics)
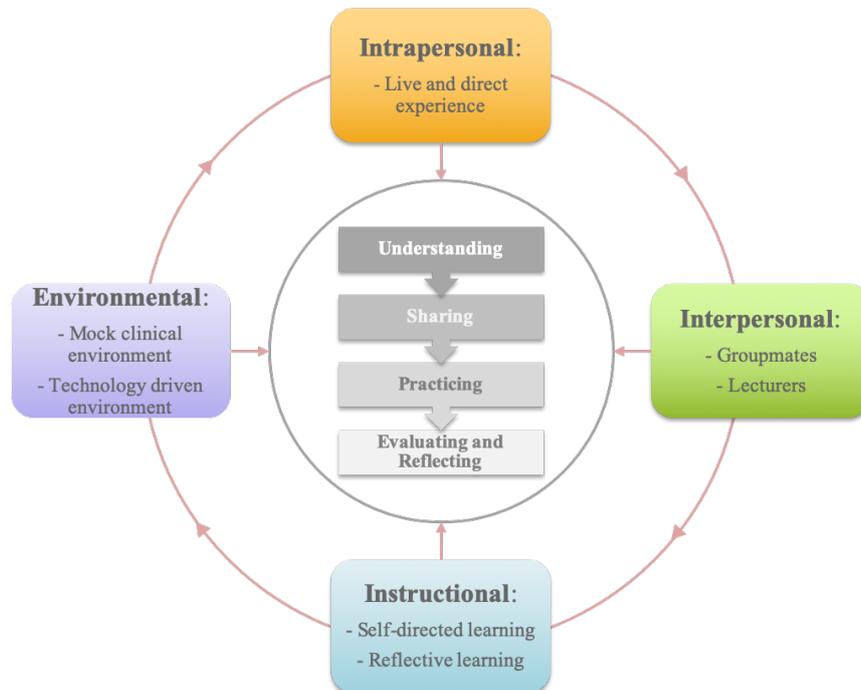
1) Nursing students' HF-SBL process

To comprehend the dynamics of HF-SBL in nursing education, four sequential stages in participants' learning processes during HF-SBL were identified in this study: 1) understanding, 2) sharing, 3) practising, and 4) evaluating and reflecting. These stages of learning form the core of the model of HF-SBL Dynamics

1. Understanding scenarios by each student (Understanding)

Prior to attending HF-SBL, a lecturer gave a set of learning material to each nursing student, including the mock clinical situations. The students then attempted to understand and address the scenarios individually based on their prerequisite nursing knowledge.

> *Before the simulation, we are informed of the learning materials [related to clinical situation] and the roles we should perform during the simulation.* (S1)

2. Sharing knowledge with other group members (Sharing)

The students were grouped, and they shared existing nursing knowledge of the scenario to co-construct collective knowledge with their group members. Each member of the group would then be allocated a role for the simulation practice (e.g. nurses or caregivers).

> *I discuss the scenario with my team members then we split up the roles…We share our existing knowledge of the situation…Our simulation is conducted on the basis of the discussion.* (S2)

3. Undertaking the practice (Practising)

To begin the HF-SBL, nursing students entered the simulation room to implement nursing practice while the lecturer controlled the patient simulator according to the scenario and only observed students' performance in the control room. The students' performance was video-recorded.

> *When I enter the simulation room, I see the [patient's] monitor. When the patient's vitals are presented on the monitor, we respond to it.* (S3)

4. Evaluating performance (Evaluating and reflecting)

Upon completion of the practice, the lecturer and students reviewed the recording to discuss and evaluate the performance in the debriefing room. Students received feedback from the lecturer and participated in a process of reflective learning.

> *I enter the debriefing room and watch the [recorded] video with the lecturer's comments. The lecturer points out our mistakes.* (S4).

2) Factors influencing the student learning experience

Four prominent factors that influenced nursing students' learning experiences in HF-SBL emerged from this research: intrapersonal, interpersonal, instructional and environmental factors. These four factors form the outer part of the model of HF-SBL Dynamics, encircling the students' learning processes.

Factor 1: Intrapersonal factors

To compensate for insufficient clinical placements in South Korea, nursing students can obtain direct learning experiences in nursing from HF-SBL while obtaining indirect learning experience during clinical placements as in South Korea, students mainly observe nurses' practice. The students believed this experience (i.e. '*direct experience via HF-SBL*' and '*indirect experience via clinical placement*' (S5)) is crucial in nursing education as they regarded nursing to be a practical role. Of these, the nursing students further stated that the knowledge obtained via direct experience is more valuable for knowledge building.

The knowledge from live experience like HF-SBL is more interesting and stays longer in my memory. I think the experience is very important to become a nurse. (S2)

Personally doing [nursing practice] is different from observation [clinical placements] … When I can actually do real nursing practice, my understanding is reinforced. (S6)

The students found HF-SBL very interesting and motivating because they can act as real nurses (i.e., role play) to perform a variety of nursing practice. With this opportunity to experience first-hand practice as nurses, the students were able to develop confidence in performing nursing practice in real clinical settings.

Simulation is interesting. When we respond actively and offer proper interventions, the simulator's condition changes and improves… I can take control of my learning during simulation. (S6)

The more I practice [through HF-SBL], the more confident I become. (S3)

Factor 2: Interpersonal factors

Students in this study stated that their learning experiences in HF-SBL were significantly affected by two groups of people: their group members and lecturers.

Since the students planned and implemented the simulation practice collaboratively with their group members, they believed that the co-construction of knowledge and teamwork were vital to their performance in HF-SBL.

It is a process of co-construction. I don't conduct it alone but with others, as a team… Moreover, cooperation with other students is one of the crucial learning goals [of HF-SBL]. (S5)

Additionally, the students stressed the importance of the lecturer not only as a supervisor, but also as being responsible for designing the HF-SBL, controlling the simulator, and most importantly, offering guidance and professional feedback to students.

Our practices are corrected as the lecturer points out the mistakes. I can review my mistakes and I think I will never make the same mistakes again because of her feedback. (S1)

Factor 3: Instructional factor

There was a common view among the students that self-directed learning was a major learning objective of HF-SBL, as students were explicitly given the chance to design the

nursing plan, make decisions and practice nursing skills independently without lecturers' guidance.

> *The HF-SBL is the education in which we lead, so we conduct this learning actively… Based on the given scenarios, we make our own decisions on our practice and carry them out ourselves.* (S6)

Reflective learning is another key component of HF-SBL. In the evaluation stage, students had opportunities to watch their recorded performance and receive feedback from the lecturer.

> *[This HF-SBL] can be called 'reflective learning'. I can reflect on my mistakes, like, 'That was good' or 'That was wrong' while watching my performance.* (S4)

Factor 4: Environmental factors

SBL takes place in university simulation laboratories which are designed to be the same as clinical environments (the HF-SBL environment in the four Korean universities is described in Appendix 1). This is because the learning goal is to increase nursing students' sense of reality in the HF-SBL environment.

> *The atmosphere of simulation room is similar to clinical environments... I think all the things usually found in the clinical environments are equipped within the room.* (S3)

Moreover, information and communication technology (ICT) devices play a critical role in HF-SBL, such as the simulator in the simulation room, the computer-based systems and recording devices in the control room.

> *Everything [in the simulation room] including the simulator is ICT... The simulator is not a real human but ICT. So, ICT plays a leading role in how we obtain information and build knowledge [during simulation].* (S10)

3) Optimising HF-SBL Dynamics

The research participants identified ways in which their learning from HF-SBL was sub-optimal. In the model of HF-SBL Dynamics, these are reflected in the outer ring and as unable to fully support the learning of the inner ring. The participants associated this with: 1) having a limited role during HF-SBL, and 2) a lack of realism during HF-SBL.

Limited role during HF-SBL

In HF-SBL, each member of the group was allocated a role for simulation practice. Some students expressed frustration that their assigned role limited their experiences of nursing practice.

> *I was allocated a caregiver's role during the simulation… I was not sure what I need to do as a caregiver. I will become a nurse, not a caregiver. So, my simulation experience as a caregiver was not useful as much as my group members who played a nurse role.* (S11)

Moreover, the students were required to provide nursing interventions according to the 'machine's functions' (i.e., the patient simulator's sensors). For this reason, the students focused on technology-led nursing practice according to how the machine works and reacts, despite feeling that they should be learning person-led nursing care.

> *When I check vital signs [of the simulator], I need to put the vital sign check devices on the sensors of the simulator. In other words, I should conduct nursing intervention according to the unique characteristics of the machine* (S6)

> *Nursing should be delivered with the heartfelt practice. If a patient is sick, a nurse should be able to feel empathy… Do you think I can learn the feeling during HF-SBL? I have learnt how to provide nursing care to simulators, not humans* (S16)

As the high-fidelity simulator is very expensive, HF-SBL lecturers would request the students to handle the simulator carefully, and to wear gloves before touching the simulator. This often discourages nursing students from conducting their usual nursing practice during HF-SBL for fear of causing any damage to the simulator.

> *I was discouraged to learn during HF-SBL when lecturers said "the simulator is expensive. You should wear gloves before using it."* (S9)

> *Lecturers always emphasise that we should go easy on the simulator… I think they [lectures] are worried about the breakdown in the simulator if we use the simulator harshly.* (S6)

Lack of realism during HF-SBL

HF-SBL seeks to provide an environment that resembles clinical settings and thus promotes a sense of reality. However, the students indicated that the realistic nature of HF-SBL was questionable. All students emphasised that "*the simulator is not human*".

The students considered the use of a simulator in HF-SBL to be disadvantageous because they were not able to have a conversation with the simulator as they would with a real patient.

It is hard when there are no real reactions from the simulator. I only talk at the
simulator… The disadvantage is that there is no [real] communication. (S3)

It [simulator] is an expensive doll anyway. (S9)

As the students knew that no harm could be caused even if they make mistakes in HF-SBL,
the students tended to not take the practice seriously.

We just apply [our practice] to a doll, pretending to do [nursing practice] rather than
actually doing it… And, [the simulator] doesn't have any feelings, so it doesn't
complain of pain. So, I end up handling the simulator harshly. (S9)

It is disadvantageous that I have to adjust and conduct my nursing practice according
to the characteristics of a machine, and not a real person's body. (S6)

As a result, the students expressed concerns about the transferability of skills learnt during
HF-SBL to real clinical situations.

The simulation environment is different from the clinical environment. So, I feel there
are limitations to applying the learning from simulation to the clinical contexts. (S1)

Discussion

By exploring South Korean nursing students' experience of HF-SBL, this study constructed
the theoretical model of HF-SBL Dynamics. The model presents the HF-SBL learning
process of four sequential steps (understanding scenarios, sharing knowledge with other
classmates, undertaking nursing practice and evaluating performance) with four factors that
influence the process (intrapersonal, interpersonal, instructional and environmental factors).
These factors shape the characteristics of the learning process. Nursing students' negative
perceptions regarding HF-SBL, which hinder the learning process, were also identified
(limited role during HF-SBL and use of simulator, and lack of realism).

In HF-SBL, nursing students are able to undertake nursing practice in a mock clinical
environment within the familiar surroundings of their university. With HF-SBL, they can
obtain greater exposure to hands-on (direct) nursing practice, which is in contrast to their role
as only observers during clinical placements (i.e., the intrapersonal factor) (Najjar, Lyman, &
Miehl, 2015; Roh et al., 2016). The students in this study preferred hands-on simulated
experiences rather than observational clinical experiences for their learning in nursing
education. John Dewey's concept of 'learning by doing' is widely known in education.
Dewey stressed the importance of experience in the learning process. He contended that '*an*

ounce of experience is better than a ton of theory simply because it is only in experience that any theory has vital and verifiable significance' (Dewey, 1916, p. 183). Although learning from non-live experience is also important, in light of Dewey's educational paradigm, learning from hands-on experience is arguably central in education. This is particularly so with nursing education, which aims to build students' competence in real clinical contexts (Yang, 2012). Lee, Clarke, Carson, and Yang (2018b) asserted that 'applying' nursing students' existing knowledge to nursing practice is a high level of the nursing knowledge building process because the knowledge obtained through knowledge application is more memorable and useful for the construction of deep, sustained knowledge. Hence, the hands-on experience of applying existing knowledge to nursing practice during HF-SBL can support nursing students to construct quality nursing knowledge. Through the direct experience of HF-SBL, students can also gain confidence in their nursing practice skills. This finding corresponds with research showing that nursing students believe HF-SBL can help them to develop confidence and self-efficacy in nursing practice under mock clinical settings (Roh et al., 2016).

HF-SBL also facilitates self-directed and reflective learning (Tutticci et al., 2018). Nursing students performed nursing roles with self-directed learning, and their performances were reviewed through the evaluation process, which facilitated reflective learning. Donovan, Argenbright, Mullen, and Humbert (2018) suggested that the debriefing stage is a key element in students' learning experience in HF-SBL as it promotes reflection-on-action as well as emotional processing (alleviating anxiety) upon completion of the practice. Similarly, students in this study believed that they can foster self-directed learning and critical thinking through reflective learning from their experiences of HF-SBL. This belief has also been identified in other Korean studies (Kim, 2018; Kim & Kim, 2017; Lee, Kim, & Park, 2015). The self-directed and reflective learning characteristics of HF-SBL correspond to the learning characteristics proposed in Constructivist Learning Theory, one of the most popular learning theories in the current era. Constructivists believe that *'knowledge is constructed by learners through an active, mental process of development, and that learners are the builders and creators of meaning and knowledge* (Gray, 1997, n.p.). In other words, the theory emphasises the individual's experience, and the learner is required to be active, reflective, and self-directed (Seels, 1989).

Constructivist learning theory also acknowledges that the context in learning is a significant component to the development of individual knowledge in the learning process (Bereiter, 1990; Vygotsky, 1980). It claims that knowledge is not only built upon one's own experiences, but also interactions with others in that environment (Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Strommen & Lincoln, 1992), which aligns with the co-

constructive learning process found in this study. Through the interaction and collaboration with other group members in HF-SBL, students can build collaborative and communication skills (Cunningham, Foote, Sowder, & Cunningham, 2018). Likewise, through interactions with lecturers in the evaluation stage, the students are able to receive professional feedback to strengthen their learning and nursing capacities through reflections on their performance (Kim & Kim, 2017).

Although HF-SBL with human patient simulators in nursing education is a learning modality to advance hands-on learning experiences in nursing education, students who participated in this study highlighted its limitations. HF-SBL is intended to provide students with a sense of reality in nursing practice (Lee & Oh, 2015; Najjar et al., 2015), with 'high' fidelity referring to high realism in the simulators and simulated clinical environment (INACSL Standards Committee, 2016). However, the students in the present study failed to experience this because they perceived that the simulator is not a real human and there was an absence of a human, two-way communication between the students and simulator. That is to say, during the HF-SBL, the Korean nursing students struggled with a lack of a sense of psychological fidelity, which is 'perceived' realism of participants regarding the simulators and clinical environment through their emotion, beliefs and awareness (Gore & Lioce, 2013; INACSL Standards Committee, 2016). As a result, the students tended to perform nursing practice carelessly as they were not able to establish psychological fidelity towards the simulator. The lack of psychological fidelity hinders the students' engagement with the HF-SBL and hence limits nursing skill development including empathy and emotional support toward patients (INACSL Standards Committee, 2016). It is concerning that this kind of careless behaviour might be carried to real clinical settings (Au, Lo, Cheong, Wang, & Van, 2016), which raises concerns about patient safety.

Some studies (Miles, 2018; Tutticci et al., 2018) stressed that HF-SBL is a useful way to equip nursing students with the abilities to transfer and apply learnt skills into clinical practice. However, this research identified that nursing students struggled to apply nursing skills learnt during HF-SBL to real-life settings, due to a dependence on the automated simulator system. The students argued that every practice they carried out was directed at specific sensors of the machine, rather than on actual human body parts. This situation would hinder the transferability of their nursing skills into real clinical situations (Meyer et al., 2014; Nash & Harvey, 2017). Hanna and Fins (2006) argued that simulation learning should integrate humanised care aspects as the relationship between a simulator and healthcare staff during HF-SBL is fundamentally different from the relationship between real patients and healthcare staff in real clinical contexts. Furthermore, the students experienced technology-led care practice during HF-SBL, although they should be nurtured to deliver person-led

nursing care when they become a qualified nurse. Ziy, Wolpe, Small, and Glick (2006) warned that overreliance on computerised simulators for healthcare education may threaten learning of person-led care.

The authenticity of the simulation environment should be seen as an important aspect of the HF-SBL experience (Haraldseid, Friberg, & Aase, 2015). Although the clinical environment is recreated as accurately as possible in the HF-SBL environment, the context of clinical environments (e.g., busy environments, and interpersonal relationships with patients and co-workers) cannot be perfectly simulated during HF-SBL as the students are surrounded by their classmates and lecturers. Furthermore, Lee et al. (2018a) have asserted that an understanding of the clinical context is a core part of nursing education. However, the factors noted above create an unrealistic experience for students, making it difficult for them to conduct nursing practice in a precise and detailed manner during HF-SBL and thus, challenging to apply their learning to the real clinical environment.

Recommendation

Dewey (1916) valued direct and live experience and stressed the importance of 'realising sense' in a learning process that is '*used to express the urgency, warmth, and intimacy of a direct experience*' (Dewey, 1916, p. 223). Dewey's ideas not only support the findings of this research, but also provide meaningful insights for nursing education. As nursing students experienced the loss of 'realising sense' in HF-SBL, nursing educators should take note about this issue of lack of psychological fidelity, and then critically review and consider revising the current HF-SBL curriculum by enhancing the fidelity to more closely resemble real-life clinical situations and contexts to reduce the gaps between student HF-SBL experiences and clinical settings. This aspect of student learning is critical to the ability of HF-SBL as an effective learning experience for students, and needs to be considered just as much as the technical competence of the simulation.

HF-SBL has become a popular strategy internationally, including in Korea, to compensate for the difficulties in finding clinical placements for students. However, nurse educators should be aware of that HF-SBL is not an alternative to clinical placement, but rather a supplementary approach for clinical skill learning.

Moreover, Ziy et al. (2006) asserted that a proper use of HF-SBL could facilitate learning of person-led care delivery. Therefore, nurse educators will be able to optimise their students' learning by developing a strategy on how to include person-led care practice in HF-SBL to equip nursing students who with the competency to deliver person-led nursing care to real patients.

Limitations

Because qualitative research emphasises the research context, the relevance of our findings is limited to the sample and cultural context of the research (i.e. final-year-undergraduate-Korean nursing students' experience of HF-SBL). However, the model of HF-SBL Dynamics offers a framework for users of HF-SBL world-wide to critique the role of HF-SBL in nursing education. It is notable that university lecturers also held an influential position in students' learning in HF-SBL, and it would be worthwhile to explore their experiences to obtain a holistic understanding of interpersonal dynamics in HF-SBL. This research only focused on the students' use of one modality (human patient simulator) and one fidelity (high fidelity) of simulation. As many nursing educators also use other modalities and fidelity along with high-fidelity simulation through human patient simulators, research that explores other modalities and fidelity will be useful.

Conclusion

There is no doubt that HF-SBL has benefits in nursing education, but nursing educators should be cautious to believe that HF-SBL is the ultimate alternative to clinical placements, due to the limitations of HF-SBL. One of the limitations is the insufficiently realistic experience for students (particularly of communication and psychological aspects of care). Although HF-SBL can mimic clinical environments, it is impossible to fully reproduce real clinical contexts and provide practice in professional socialisation. Clinical environments are irreplaceable in nursing education, and HF-SBL is not a panacea for learning issues in clinical placements. HF-SBL is rather more effective in nursing education as a supplementary instructional strategy, together with formal clinical placements, which ultimately lead to conclusion that educators and professionals in the health care settings should collaborate to enhance the clinical learning environments.

Appendix 1: The educational environment of a high-fidelity simulation-based learning in the four universities

The educational environment of a high-fidelity simulation-based learning contains three different rooms (i.e., simulation, control, and debriefing rooms):

- Simulation Room
    The design of the simulation room is resemble to the intensive care unit environment in hospitals. This is the room where the nursing students perform their nursing practice

simulation with their group members according to the clinical scenarios developed by the universities. In this room, a human patient simulator (SimMan®) is placed on a hospital bed while the patient's vital signs and conditions are showed on an overhead monitor. Around the bed, there is a set of basic medical and nursing equipment for students to use during the simulation. The university lecturers operate the patient simulator and monitor in a separated room next door (the control room).

- Control Room

   The control room is located next to the simulation room, and it allows the lecturers to sit in the room and examine the students' nursing performance in the simulation room through a one-way glass. It means that only the lectures can see the students across the room but not vice versa. During the simulation, the lecturers also control the patient simulator and monitor by reflecting patient's medical condition. The lecturers can communicate with the students via a microphone. The entire simulation is conducted based on the scenario given to the students prior to the simulation practice. In addition, cameras are set in this room to record the students' nursing practice during the simulation for evaluation purpose.

- Debriefing Room

   The debriefing room is a typical classroom setting, and it is a place where the last stage of the simulation-based learning (evaluation) takes places. Once the students complete their simulation, they enter this room to watch the recorded videos of their nursing practice. Afterward, the university lecturers and students discuss and examine the students' simulation experience and performance. Besides the students being evaluated, other students in the class are also allowed to join the debriefing session in this room, to watch their peers' performance so that they can learn from others' experience.

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