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Evidentiary and theoretical foundations for virtual simulation in nursing education☆

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ABSTRACT

Virtual simulation has been used extensively in nursing education since the beginning of the COVID-19 pandemic due to the unavailability of clinical sites. Extant research supports substitution of up to 50% of nursing clinical hours with simulation. However, in many nursing programs virtual simulation is currently substituting more than half of traditional clinical hours, and the knowledge gaps and limitations surrounding virtual simulation exist. The purpose of this paper is to describe the evidentiary and theoretical foundations for virtual simulation. Through examination of adult learning theories, learning styles and Bloom's Revised Taxonomy, recommendations for maximizing the use of virtual simulation in the current clinical learning environment are outlined. Debriefing is a vital component of virtual simulation. Synchronous debriefing with nursing students, faculty, preceptors, and peers provides the opportunity for scaffolding to support students' learning needs and foster reflection and evaluation to mitigate shortcomings of virtual simulation in the current clinical learning environment.

Introduction

The development and use of virtual simulation (VS) in pre-licensure, baccalaureate and graduate nursing education has greatly expanded in the last decade. In spring 2020, the COVID-19 pandemic made many clinical sites and nursing skills laboratories unavailable to nursing students for clinical practice experiences. Consequently, many nursing students' progression and completion of their nursing programs have been dependent on VS (Fogg et al., 2020; Morin, 2020). National guidelines based on extant research, recommend simulation in nursing programs to substitute for up to 50% of in-person clinical time (Alexander et al., 2015; Hayden et al., 2014). However, during the COVID-19 pandemic, VS has been substituting more than 50% of clinical time (Fogg et al., 2020). While this substitution has been necessary, little is known about how extended use of VS beyond 50% of real clinical time will affect the overall learning outcomes.

Today's healthcare system is complex and health care settings are shifting from acute care to more community-based care. Nursing care is becoming increasingly specialized, and nursing students must be prepared for diverse patients in multiple care settings (Benner et al., 2010; Jeffries, 2015). With the shift in care settings, it is becoming increasingly difficult to find clinical sites and clinical experiences for nursing students. Advances in nursing education simulations offer students the opportunity to learn in situations similar to patient encounters (Jeffries, 2005).

Purpose

The purpose of this paper is to describe the use of VS in nursing education, and its expanded use during the COVID-19 pandemic. The evidence base for its use and the theoretical foundations will be examined, and gaps in knowledge will be identified and critically discussed to maximize the usefulness of VS in nursing education. Theoretically-based recommendations for expanded use of VS will be outlined.

VS in nursing education

Traditional practice

Simulations are activities that mimic real-world practice, such as basic life-support on a patient simulator. The realism of the simulations is understood as fidelity and ranges from low, such as case studies and

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Table 1
Definitions of commonly used simulation terms.

Term	Definition
Asynchronous virtual simulation (VS)	• A VS that can be completed without a facilitator being online at the same time as the learner. Often based in an online computer program.
Avatar	• A virtual representation of a human often capable of displaying physical responses and facial expressions (Riley, 2008).
High-fidelity simulator	• A full-body simulator capable of mimicking human body functions at a very high level utilized in a simulation laboratory (Lioce et al., 2020).
Remote-controlled simulation (also known as synchronous VS)	• Simulations conducted by a facilitator that is in a separate location (e.g., simulation laboratory) from the learner. Remote-controlled simulations can be facilitated live via web-based video conferencing (Christensen et al., 2015).
Virtual reality (VR)	• An immersive three-dimensional virtual environment (Lioce et al., 2020). Virtual reality is often projected into a head mounted display (Chang & Weiner, 2016).
Virtual simulation (VS)	• A simulation in which a person operates a computer simulated virtual reality depicted on a computer or is virtually connected to a learning environment (Lioce et al., 2020).

static manikins, to high-fidelity simulations that include patient simulators and virtual reality with a high level of interactivity and realism (Meakim et al., 2013; Padilha et al., 2019). VS is categorized as high-fidelity screen-based experiences. The learner takes the central role by exerting motor control skills, making decisions, and practicing communication skills (Foronda et al., 2020). Some VS technologies are developed to be used with high-fidelity mannequins in the nursing laboratory. For example, remote-controlled simulation is a form of VS in which the facilitator and learner are not in the same location, but facilitation occurs synchronously via web-based video conferencing (Christensen et al., 2015). Other technologies use online avatars and are accessible from the students' personal computers (Foronda et al., 2017). See Table 1 for definitions of commonly used simulation terms.

Implementing simulation into curricula requires a systematic and organized approach. The curriculum must be thoroughly assessed to understand the program's intricacies and determine how simulation will be connected with the goals for theory and clinical learning (Jeffries, 2005). Jeffries et al. (2015) developed the NLN Jeffries Simulation Theory to provide a structure and outline for simulation in nursing education. The theory's core concepts are context, background, design, educational practices, simulation experience, and outcomes (Cowperthwait, 2020; Jeffries et al., 2015). In addition, standards of best practice for simulation designs have been developed for nursing education (INACSL Standards Committee, 2016). Unlike traditional classroom teaching, simulation is student-centered, where the teacher is a facilitator of the student's learning process (Jeffries, 2005).

Debriefing is a key feature in simulation and is understood as the process of the learner's reflection or reexamination of the clinical scenarios. The debriefing is the opportunity to link the simulation experience to real-world experiences, adjust behaviors, and acknowledge emotions. The teacher's role is to support the student's debriefing and reflection processes, such that simulation represents the shift from a teaching focus to a learning focus (Jeffries, 2005; Padilha et al., 2019).

Prior to the COVID-19 pandemic, the use of VS was limited. Many faculty were unfamiliar with VS offerings and how they could be implemented into the curriculum. Previously, VS scenarios were utilized as pre-simulation activities (McParland et al., 2019), in-class activities (Heinrich et al., 2012), and to make up missed clinical time (Goncalves & Watson, 2019). When used as a pre-simulation activity, faculty assigned a VS scenario on a topic related to an upcoming traditional (face-to-face) simulation. This pre-simulation activity exposed students to a scenario similar to what they would experience in their traditional simulation. As an in-class activity, a VS scenario can be completed in small groups or as a whole class where actions, interventions, and decisions can be discussed. Additionally, VS can be assigned as clinical makeup time to be completed asynchronously (Goncalves & Watson, 2019).

VS during the COVID-19 pandemic

The COVID-19 pandemic caused a reduction or elimination of in-hospital clinical experiences (Morin, 2020). This increased the use of VS and led faculty to be innovative and create or adopt new virtual simulated activities, often for the first time. VS became a replacement for clinical time, and students were assigned commercial web-based VS to complete asynchronous or synchronous simulated telehealth visits (Fogg et al., 2020). Faculty would then meet with their students via web-based video conferencing tools to give a handoff report (Fogg et al., 2020), similar to a clinical post-conference. Some faculty developed a combination of activities, including asynchronous pre-simulation activities (i.e., case studies, and care plans), prior to meeting synchronously to view and debrief a series of previously recorded simulations (Esposito & Sullivan, 2020). Many colleges of nursing opted to use open-source simulations to reduce the cost to both colleges and students (Konrad et al., 2020). Previously, nursing regulatory bodies recommended that up to 50% of clinical time could be replaced by simulation, with each state having slightly different guidelines (Bradley et al., 2019). In light of the COVID-19 pandemic, several nursing regulatory bodies made changes to these mandates to facilitate the completion of clinical activities (National Council of State Boards of Nursing, 2020). With more schools opening up, didactic content delivery is returning to pre-COVID methods. However, difficulties still exist in clinical education. There are fewer learning opportunities within hospital clinical sites (e.g., students unable to care for COVID patients or work on COVID units), burnt-out nurses, and varying clinical facilities vaccination requirements. Thus, VS is still widely used in nursing education (Ulenaers et al., 2021).

Approach to examining VS

Examination of the evidence base

National guidelines for pre-licensure nursing programs allow for simulation to substitute up to 50% of the real clinical time (Alexander et al., 2015). These guidelines are based on the longitudinal, randomized, controlled trial by Hayden et al. (2014) with 666 pre-licensure nursing students from 10 nursing programs in the United States. Students had either traditional clinical experiences (control group), or 25% or 50% (intervention groups) of their clinical hours replaced by high-fidelity simulation. Hayden and colleagues found no statistically significant differences in nursing knowledge and clinical competency at the time of graduation and at six weeks, three and six months after graduation between the intervention groups and the control group. There were no statistically significant differences in NCLEX® passing rates and students reported that their learning needs were met (Hayden et al., 2014). Since then, other studies have revealed similar findings. Foronda et al. (2020) conducted a large systematic review with 80 included studies to identify how VS impacted nursing students' learning outcomes. The review focused on the five outcomes of learning (knowledge), skill performance, critical thinking, learner satisfaction, and self-confidence. Overall, 86% of the studies found that VS resulted in improved student learning outcomes. Specifically, 13 out of 15 randomized clinical trials that examined students' learning (e.g., knowledge, discovering, improved academic performance) demonstrated an increase in learning.

Research findings indicated that nursing students perceived VS as

engaging and enjoyable. They appreciated the flexibility of the technology, with some programs being available from home and on the students' own time (Foronda et al., 2020; Hayden et al., 2014; Verkuyl et al., 2019). However, technology issues are challenging with VS, and they can interfere with the learning experiences and cause frustration and anxiety (Cobbett & Snelgrove-Clarke, 2016; Foronda et al., 2020). In addition, Foronda et al. (2020) reported mixed evidence for how VS affected nursing students' self-confidence. Results from some randomized clinical trials demonstrated an increase in students' self-confidence, where others found no difference or a decrease in self-confidence compared to traditional learning. Moreover, there were conflicting findings regarding the retention of learning over time, where some studies reported improved retention of learning over time and others found no difference. These conflicting findings may be due to the imperfect nature of measures. However, the findings in the studies included in the review by Foronda and colleagues did not indicate that VS worsened student learning outcomes in regard to academic achievement.

A critical limitation of VS outlined by Foronda et al. (2020) was the variations in debriefing or potential lack of debriefing processes. Some VS programs have debriefing sessions embedded in the game (Foronda et al., 2017; Verkuyl et al., 2020), and other debriefing processes are facilitated by the nursing instructor. Research on debriefing and best practice methods in VS are limited.

There is a gap in knowledge regarding the amount of time nursing students should spend on VS (Foronda et al., 2020). Despite recommendations from the National Council of State Boards of Nursing (NCSBN) in 2015, individual state boards of nursing (BON) did not establish consistent regulations for the use of simulation in nursing programs. There are no uniform regulations for how long and how much simulation is optimal, and nursing programs decide on their own. The great variability in regulations for simulation use challenges the consistency of learning outcomes (Bradley et al., 2019). This inconsistency of regulations may be due to the knowledge gap in the method of simulation delivery, and this gap in knowledge has been further broadened with nursing students having spent more than half and potentially all of their clinical time in VS during the COVID-19 pandemic.

Limited attention has been given to the setting of simulation. VS can occur both at the nursing laboratory with high-fidelity mannequins or take place virtually on the student's computer at home (Foronda et al., 2017). In the longitudinal study by Hayden et al. (2014), the high-fidelity simulation occurred at the nursing school laboratories, similar to recent studies (Mabry et al., 2020; Padilha et al., 2019). During the COVID-19 pandemic, many nursing students have completed VS from their homes (Morin, 2020). Limited evidence suggested that nursing students' preferred the face-to-face simulation that led to less anxiety than individual simulations (Cobbett & Snelgrove-Clarke, 2016). How participating in VS at home compares to VS in the nursing laboratory is unclear. While the INACSL Standards of Best Practice for Simulation Designs (INACSL Standards Committee, 2016) exist, these standards do not specifically apply to VS or to the extended use of VS beyond 50% of real clinical time. Adding to this knowledge gap is the lack of evidence on debriefing processes. A combination of self-debrief and a group debrief is effective (Jeffries, 2005; Verkuyl et al., 2020). How debriefing is being conducted after VS at home, and how VS affects student learning outcomes is unexplored.

Theoretical foundations for VS

Adult learning theories

Adults learn differently from children and the term "andragogy" is understood as the science of adult learning (Darden, 2014; Knowles et al., 2005). Knowles' (1973) andragogy model is based on the assumptions that adult learners have the need, the ability, the desire to control and the responsibility for their own learning. Adult learners are self-directed and have life experiences that serve as resources for their own and other's learning (Darden, 2014; Knowles et al., 2005). Adults develop their readiness to learn from life problems and their orientation to learning is task- and problem-centered. Adult learners prefer being involved in the learning process and they desire connectedness and collaboration with faculty and peers (Darden, 2014; DeCelle, 2016). Supportive guidance and feedback are especially important for adult learners and nursing students in online education (DeCelle, 2016; Sitzman, 2010).

Learning theories describe the teaching-learning processes underpinning the interaction between the teacher and the student, the subject matter, and the learning environment. Learning theories provide the structure guiding learning activities and instructional strategies (Bevis, 1989; Candela et al., 2006). Behaviorism, cognitivism, and constructivism are three primary learning theories in nursing education (Brandon & All, 2010; Torre et al., 2006). Behavioral learning theory focuses on learned behavior that is measurable, observable, and empirical, and the teacher is the facilitator of learning (Torre et al., 2006). Classical conditioning is where the behavior becomes a reflex response to a stimulus, and operant conditioning is when a behavior is learned by reinforcement of reward or punishment enabling the individual to associate a behavior and a consequence (Skinner, 1985; Torre et al., 2006). While behaviorist learning pedagogy was central to nursing education in the 1970s, behaviorism is still widely utilized in both classroom and clinical settings. Learning objectives in the behaviorist paradigm include teaching procedures such as giving injections (Bevis, 1989). Behavioral learning is embedded in the simulation where students learn clinical skills that can be evaluated by an instructor or evaluated within the VS program (Foronda et al., 2017; Jeffries, 2005).

Cognitive learning theory built on behaviorism by focusing on the cognitive processes between the stimulus and the behavior and central concepts are attention, language, memory, and thinking. Cognitive learning theory is instructor-centered, yet the student takes a more active role in cognitive processing strategies to memorize and organize information (Lewin, 1951; Torre et al., 2006). In nursing education, cognitivism is apparent when the students learn concepts of pathophysiology. VS is especially appropriate for cognitive learning since students learn critical thinking and clinical reasoning (Jeffries, 2005). Understanding and applying concepts of pathophysiology and pharmacology to practice is challenging for nursing students (Benner et al., 2010). VS can aid this process. Some programs provide the student with "x-ray visuals" where they see images of, for example, the heart slowing its pace after the student administered a medication (Foronda et al., 2017).

The constructivist theory posits that individuals construct their knowledge and understanding of the world through experiences and by reflecting on those experiences (Brandon & All, 2010; Torre et al., 2006). Vygotsky's (2012) concept of Zone of Proximal Development (ZPD) is where learning objectives are just beyond the individual's current knowledge level and new knowledge is built through social interaction and instruction from teachers and peers. Learning in the ZDP occurs in four stages: (a) performances are assisted by others such as teachers; (b) the student now controls and has the responsibility for the performance; (c) learning is internalized and consistent performance is developed; (d) when what was previously learned is no longer automatic, such as after stress or trauma and the student returns to previous stages (Sanders & Welk, 2005). The ZPD is the foundation for the concept of scaffolding, which is the process of providing students support as they move through the four stages of ZDP until they can apply the new strategy independently (Sanders & Welk, 2005). Constructivist teachers pose learning activities and then guide the students to find their answers. The learning environment is active, reflective, collaborative, and evolving (Brandon & All, 2010; DeCelle, 2016). Scaffolding strategies include role modeling (skills, behavior, and communication), constructive feedback, questioning (from teachers and peers), and cognitive structuring (concept mapping and collaborate debriefing)

(Sanders & Welk, 2005). Scaffolding can be embedded into the VS programs, and is most evident in the debriefing process, where simulation scenarios are linked to real-world experiences (Jeffries, 2005). For example, during a synchronous debriefing session with faculty and students, role-modeling can be demonstrated by the instructor, concept mapping can be encouraged to link concepts from different scenarios, and constructive feedback can be provided to the group and individually. Thus, the students can reflect on their behaviors and attitudes and gain new knowledge from the VS (INACSL Standards Committee, 2016; Sanders & Welk, 2005). Providing adequate debriefing opportunities is essential to ensure constructivist learning from the VS.

Learning styles

Learning styles are the unique ways individuals move through the learning cycle of experiencing, reflecting, thinking, and acting (Kolb & Kolb, 2013). Learning styles are students' preferences for learning efficiently and effectively (Fogg et al., 2013). Identifying students' learning styles at the beginning of undergraduate nursing programs can help students use their preferred learning style to improve learning outcomes throughout their educational journey. Students' learning styles should be used as a guide to understanding students' learning needs (Choi et al., 2008). The commonly used Kolb Learning Style Inventory (LSI) (Kolb & Kolb, 2013) is an experiential learning model that includes four learning style preferences. The accommodator is a learner who prefers hand-on learning, using a combination of active experimentation and concrete experiences. The assimilator learns by reasoning, by placing information into logical forms, and uses reflective observation and abstract conceptualization. Convergers use a combination of abstract conceptualization and active experimentation to find practical uses for theories and ideas, and divergers use concrete experiences and reflective observation to look at situations from different points of view (Fogg et al., 2013; Kolb & Kolb, 2013). Even though learning styles are an important aspect of students' needs and influence learning outcomes, there is a lack of research exploring learning styles within VS (Foronda et al., 2020). Fogg et al. (2013) found no significant differences in nursing students' perceived benefit of using a virtual community learning intervention in relation to learning style. The findings suggested that all nursing students may benefit from a virtual intervention. Foronda and Bauman (2014) suggested using VS in the classroom to accommodate different learning styles. VS has the potential to adapt learning experiences to learning styles, and the innovation may already accommodate different learning styles. For example, students' preferred learning styles can be addressed by allowing options for roles within scenarios and selecting between synchronous and asynchronous simulation scenarios (Fountain & Alfred, 2009). In addition, alternative navigation designs can allow students with different learning styles to obtain either abstract or specific information about the VS before or after the scenario. The VS design can also be adapted to provide both audio, visual or written information (Choi et al., 2008). However, further research is needed to determine how learning styles can be incorporated into the VS.

Bloom's Revised Taxonomy

Bloom's Taxonomy is a framework used for the classifying statements of what students are expected to learn from instruction and the taxonomy has had a great influence on the field of education worldwide for decades (Forehand, 2010). The first publication of Bloom's taxonomy from 1956, focused on the cognitive domain of learning. Later, the affective and psychomotor domains of learning were added (Cullinane, 2010; Olatunji, 2014). With advances in cognitive psychology and educational objectives, the taxonomy was revised in 2001 (Anderson, 2005; Krathwohl, 2002). Bloom's Revised Taxonomy has been widely used in nursing education since it can promote congruence between intended learning, instructional activities, and evaluation methods (Russell, 2019; Su et al., 2004). The cognitive, affective, and psychomotor domains mirror the knowledge, attitudes, and skills nursing students need to provide safe care. The categories in the taxonomy allow nursing students to move from concrete to abstract and from basic to complex concepts (Russell, 2019). For simulation, Bloom's Revised Taxonomy (Krathwohl, 2002) can guide the development and evaluation of learning outcomes and guide the development of simulation scenarios for either instruction or evaluation (Jeffries et al., 2015). Learning outcomes within the cognitive domain are factual, conceptual, procedural, and metacognitive nursing concepts, and students understand, analyze, and evaluate knowledge (Russell, 2019). Learning outcomes in the psychomotor domain are nursing skills, where students learn to manipulate, demonstrate, and articulate procedures. High fidelity mannequins are especially appropriate for this type of learning goals and evaluation (Jeffries, 2005). Learning in the affective domain focuses on students' feelings, attitudes, and beliefs. The students learn and are evaluated on their ability to respond, discuss, organize, and value nursing concepts and phenomena. Debriefing sessions are especially important in learning and evaluating within the affective domain (Jeffries, 2005).

Gaps in knowledge

VS has been integrated into nursing education and extant research supports the substitution of up to 50% of clinical hours with simulation, without impairing nursing students' clinical competencies (Hayden et al., 2014). A theoretical framework has been developed as a foundation for simulation (Jeffries et al., 2015). VS in nursing education is supported by adult learning theories, Bloom's Revised Taxonomy and has the potential to accommodate different learning styles and provide a more culturally diverse and inclusive learning experience (Kolb & Kolb, 2013; Russell, 2019).

However, significant knowledge gaps surround this innovation, regarding how much and what kind of VS is beneficial (Foronda et al., 2020). With lack of evidence follows a lack of regulations from boards of nursing, and there may be significant inconsistencies in clinical competency in nursing programs throughout the United States (Bradley et al., 2019). A paucity of research has explored the effects of where VS takes place. Whether or not nursing students receive the support and debriefing needed when the VS is completed outside the nursing school is unknown. The COVID-19 pandemic has illuminated the gaps in knowledge surrounding VS.

In traditional clinical settings, scaffolding is provided both by clinical instructors and faculty, as well as by nursing staff in the clinical setting. With VS substituting more than 50% of real clinical time and potentially all clinical time due to the COVID-19 pandemic (Fogg et al., 2020), the scaffolding in the learning process provided by clinical faculty and nursing staff may have been greatly reduced. It is unknown, and may vary greatly throughout the United States, how much support nursing students receive from clinical staff and nurses during their current VS clinical experiences. How these important aspects of adult learning affect the learning process and clinical experiences are unknown.

Benner et al. (2010) called for a transformation of nursing education since nursing students were unprepared for their practice demands. VS is one way to bridge this theory to practice gap (Foronda et al., 2017). Benner et al. (2010) support situated and experiential learning. However, they are critical of moving the "situation" away from real-life patient encounters. VS may substitute up to half of the clinical experiences, but not all clinical experiences, and nursing students must experience real-life relationships with patients. Little is known about the long-term effect of VS on nurses' competencies, caring practices, and patient outcomes, as well as how the amount and setting of VS affect nursing students' learning outcomes (Foronda et al., 2020).

Recommendations for optimizing the use of VS

Implementing simulation into curricula requires a systematic, and theoretically founded approach (Jeffries et al., 2015). With the current increase in VS use, greater attention should be paid to the empirical

Table 2
Theory-based perspectives to optimize the extended use of VS.

Theory	Recommendations for VS
Andragogy	• Ensure that nursing students have regular faculty and peer support throughout the VS learning process. • Allow reflection on past clinical or personal experiences both individually and with peers and faculty.
Bloom's Revised Taxonomy	• Ensure that not only the cognitive and psychomotor domain is embedded in the VS environment, but the affective domain as well. • Affective domain is best addressed in debriefing sessions with faculty and peers. • Outline clear objectives for the VS that contribute toward achieving learning outcomes (INACSL Standards Committee, 2016)
Debriefing	• Synchronous debriefing must occur on a regular basis in group settings, to replicate a traditional post conference experience. • Clinical faculty and preceptors from the clinical setting can facilitate debriefing. • The simulated experience and debriefing should be evaluated regularly (i.e., the Simulation Effectiveness Tool-Modified) (Leighton et al., 2015).
Learning styles	• Assess the nursing students' preferred learning styles. • Evaluate and individualize nursing students' preferred learning style in the VS experiences. • Provide options for different nursing roles within scenarios and selecting between synchronous and asynchronous simulation scenarios (Fountain & Alfred, 2009). • Provide alternative navigation designs for students to obtain either abstract or specific information needed either before or after the scenario. • Provide information in the VS scenario in different formats, such as audio, visual or written information (Choi et al., 2008).
Scaffolding	• Include clinical and academic faculty in the VS environment. • Each VS must build on previous experiences. • Allow opportunities to discuss VS experiences with nurses in care settings to minimize the gap between VS and clinical practice. • During synchronous debriefing sessions, constructive feedback can be provided to the group as well as individually. • Concept mapping can be encouraged to link concepts from different scenarios and real world clinical experiences. The concept map can then be discussed during synchronous debriefing sessions (INACSL Standards Committee, 2016; Sanders & Welk, 2005).

knowledge gaps (amount of time spent in VSs, debriefing processes and setting), and theoretical gaps (affective learning outcomes, accommodating learning styles, scaffolding and adult learning needs). See Table 2 for theory-based perspectives for optimizing the extended use of VS based on current theoretical foundations and evidence base.

While adult learners are self-directed and their learning is problem-centered, they need teacher guidance (scaffolding) in a constructivist approach to teaching and learning. The instructor must fully understand the students' VS clinical experiences to provide sufficient support and debriefing. Until further research has been conducted to evaluate the debriefing of VS that takes place remotely, debriefing should occur with faculty and peers in person or with on-line meetings. The VS must be continuously critically evaluated by faculty and program directors to ensure that the innovation is theoretically founded, and that students' learning needs are met.

Nursing theories guide nursing research and practice, and theory development is an essential component of the nursing discipline (Walker & Avant, 2011). Theorizing is embedded in practice and theories are typically used for problem solving, decision making, critical thinking and clinical reasoning. However, theories should be advanced to identify conceptual relationships and nursing care outcomes (Reed & Lawrence, 2008). As discussed, VS is theoretically founded and has a sound evidence base (Jeffries et al., 2015). Yet, this foundation was built for VS replacing up to 50% of real clinical time (Hayden et al., 2014). A less conventional strategy for theorizing that evolves out of the context of nursing practice and education is referred to as "guerilla theorizing" (Reed, 2018). Guerilla theorizing involves pragmatic, bold, and creative theory development by nurses and nursing faculty as they engage in practice and education. Guerilla theorizing can produce nursing knowledge that is context and practice near and that addresses current practice needs. In guerilla theorizing, the nurse and nurse educator creatively integrate existing theories and their current situation and actions to develop knowledge "in the wild" that is situated in the context in which actions occur (Reed, 2018). Nursing faculty and preceptors in any setting can collaborate and guerilla-theorize to further develop knowledge to support shortcomings in nursing students' lack of real clinical time and extensive use of VS. For example, nursing faculty and preceptors can collaborate in creating debriefing sessions where VS scenarios, students' past clinical experiences, and preceptors' clinical experiences can be combined and thereby enhance nursing students' clinical learning. While the COVID-19 pandemic has posed many challenges, this is also an opportunity for creative innovations and collaboration among nurses to enhance nursing education and practice.

Conclusion

VS can bridge the gap between theory and practice in nursing education and has been a vital component to educate future nurses during the global health crisis. Limitations and knowledge gaps surround VS and its extended use, such as lack of debriefing with academic and clinical faculty and peers, scaffolding, and amount of time spent in VS. Until further research has been conducted, nurse educators must continue to evaluate each VS experience and ensure that students' cognitive, psychomotor, and affective learning needs are met. Synchronous debriefing sessions with nursing faculty, preceptors and peers may limit shortcomings in the extended use of VS and support nursing students in their learning process based on learning styles and adult learning needs. The current COVID-19 pandemic poses opportunities for nursing preceptors and faculty to collaborate in developing theory and new knowledge that will improve nursing education and clinical practice in the future.

Declaration of competing interest

None.

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