Using Artificial Intelligence and Gaming to Improve New Nurse Transition

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New nurses transitioning to practice must develop clinical reasoning skills enabling safe patient care delivery. Time and exposure necessary to develop expert-situated cognition present a challenge for new nurses. Educational interventions have been proposed as solutions in a complex, cognitively and emotionally demanding environment. Artificial intelligence technology may provide innovative approaches to influence cognitive development. Preliminary pilot study data evaluating virtual reality (VR) simulation education for new nurses recognizing and responding to respiratory decline in hospitalized infants are remarkable. Data suggest that new nurse learners are responsive and receptive to VR education, and VR training may be more effective than traditional teaching modalities in some situations.

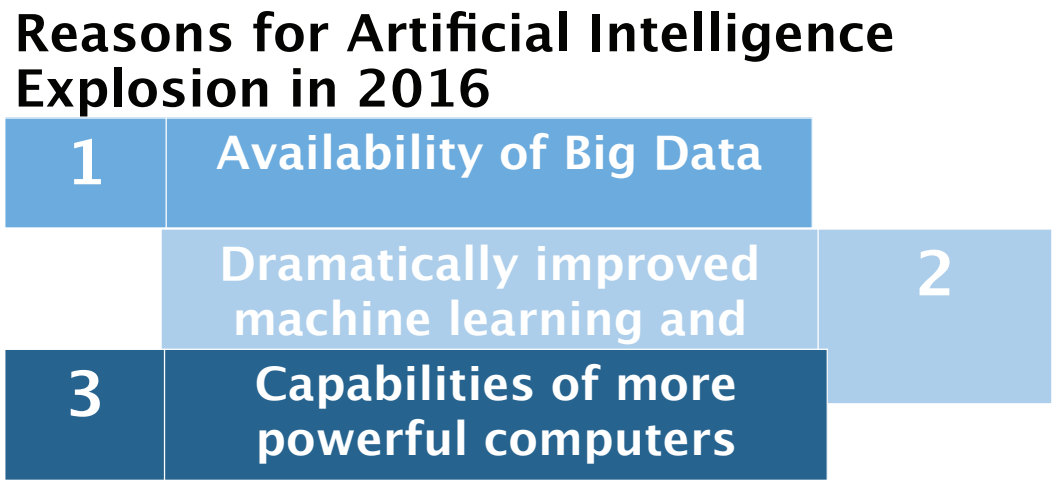
New nurse turnover costs organizations an estimated $1.4 billion to $2.9 billion/year in the United States.[1-3] Reducing graduate nurse turnover can decrease costs, combat nursing shortages, and improve patient outcomes.[2] Consider a medium-sized hospital with 40 intensive care unit (ICU) beds employing 100 ICU nurses with an annual turnover rate of 17%. The hospital's cost related to ICU nursing turnover would be approximately $1,105,000 per year.[4] Studies reveal transitions to professional practice programming (TPPP) resulting in self-confidence, a positive preceptor experience, and resilience were key to first-year retention rates.[2] The relationship between TPPP and resiliency was compared in one cohort of nursing graduates.[5] Professional satisfaction fluctuated the first year of practice. At 12 months post-graduation, only 57% of the respondents felt their education prepared them for the reality of nursing practice.[5]

Educational interventions and nursing curriculum revisions have been proposed as solutions to overcome challenges encountered in the complex, cognitively and emotionally demanding acute care environment.[1] Meyer and colleagues[1] found that revision of nursing curriculum can have a positive influence on professional and job satisfaction 3 months post-graduation, and graduates who demonstrated poorer transition to practice at 3 months were more likely to leave their first positions by 12 months. Clearly, the determination of what constitutes effective TPPP modalities, not simply curriculum revision, warrants further exploration.

Artificial intelligence (AI), defined as the development of information systems to imitate intelligent human behavior[6] may offer an avenue to learning positive-influencing transitions for new nurse learners. The purpose of this article is to describe current issues with nurse transition to practice, consider application of artificial intelligence options to improve new nurse transition, and describe the preliminary results of a pilot study using virtual reality technology as a teaching method to examine the new nurse recognition and response to respiratory decline in hospitalized infants.

CURRENT ISSUES WITH TRANSITION TO PRACTICE

New nurses transitioning to practice are exposed to—and some might suggest cognitively bombarded with—an abundance of new information. The question remains how best to introduce, pace, and integrate learner information into cognitive, psychomotor, and organizational learning processes. The Carnegie Foundation for the Advancement of Teaching released results of the first national nursing education study in over 30 years.[7] This seminal work led by Benner et al.[7] called for radical changes in nursing practice in the education of nurses and preparation of nurse educators. Benner's *From Novice to Expert*[8] describes how a combination of strong educational foundations and personal experiences help nurses develop cognitive skills and an understanding of patient care over time. Expert nurses no longer rely on principles, rules, or guidelines; rather they have a deeper background of experience and an intuitive grasp of clinical situations.[9]



Executive Office of the President, National Science and Technology Council Committee on Technology (2016). Preparing for the future of artificial intelligence. Retrieved from https://info.publicintelligence.net/WhiteHouse-ArtificialIntelligencePreparations.pdf

Figure 1. Reasons for Artificial Intelligence Explosion in 2016

Clinical grasp is influenced by nurse situation awareness defined as "a dynamic process in which a nurse perceives each clinical cue relevant to the patient and his or her environment; comprehends and assigns meaning to those cues resulting in a patient-centric sense of salience; and projects or anticipates required interventions based on those cues."[10(p.89)] Nurse knowing has been identified as a consistent theme as expert nurses consistently assign meaning to a culmination of subtle cues influencing a macro level of assigned meaning that isn't as apparent in nurses with less than 24 months' experience. Direct care clinical nurse experts do not simply know more, they know differently, enabling them to see and interpret what might be otherwise invisible to direct care nurses with less than 24 months' experience.[11] Over time and with repeated exposure to clinical situations, the nurse learner develops a mental representation of physiological normal and starts to understand when a patient situation is problematic and needs to be resolved. In such situations, nursing cognition becomes a form of inquiry, and is understood as a hands-on practical activity through which the nurse transforms the situation into one that is less confused and more comprehensible (situated cognition). The time and exposure necessary to develop expert-situated cognition presents a challenge when more than 50% of direct care nurses in many nursing units have less than 24 months' experience.

We must face the challenges of transforming curricula and teaching methods to support the cognitive, psychomotor, and organizational learning process required of our new nurses. Some studies suggest that new nurses may benefit from simulation training.[12] Application of AI technology in the learning environment may be an approach to expedite the cognitive, psychomotor, and organizational learning that positively influences transition to practice.

AI exploded in health care in 2016 (*Figure 1*).[13] Today's AI probability-based systems can reason on their own and are capable of deep learning, neural networks, and natural language processing. Examples of AI software programs include serious gaming, gamification, VR, and augmented reality (AR). These systems can "understand, learn, predict, adapt and appear intelligent."[14] Their ability to learn is key to their functionality.

AI: SERIOUS GAMING, GAMIFICATION, VR, AND AR APPLICATIONS AS OPTIONS

Serious Gaming and Gamification

As described, examples of AI software programs include serious gaming, gamification, VR, and AR (see *Table 1* for a quick comparison). Computer games, prevalent in today's culture and often used for their entertainment value, can be used for serious purposes, also known as serious games. Serious gaming involves developing educational or training games for the purpose of meeting educational objectives during the gaming experience. Related to serious games is gamification, or the use of game design elements and game mechanics (trophies, badges, and leaderboards) in nongame contexts.[15] Both serious gaming and gamification seek to employ games (or substantial game elements) to educate and change patterns of experience and/or behavior. Zielke et al.[16] identified concepts serious games can provide such as the ability to represent complex relationships, provide nuance, set difficulty levels, and have

Table 1. Types of Artificial Intelligence and Training Application

AI Modality	Description	Benefits	Devices Needed	Examples: Video Links
Serious gaming	Development of educational or training games for the purpose of meeting educational objectives during the gaming experience	Active, problem-solving form of learning with rapid and differentiated feedback; review the game content at will	Computers, smart phones, tablets, or other gaming type devices	Serious Games Conference 2017: Neonatal Resuscitation Game: https://www.youtube.com/watch?v5J-xlsLsbt8M
Gamification	Use of game design elements and game mechanics (trophies, badges, and leaderboards) in nongame contexts	Employ games to educate and change patterns of experience and/or behavior	Computers, smart phones, tablets, or other gaming type devices	
VR	Realistic immersive simulation of a 3-dimensional environment using interactive software and hardware that is experienced and controlled by body movements and/or hand controllers	Three-dimensional imaging and the ability to actively interact with the VR environment with visual and auditory feedback	Head-mounted apparatuses	VR's Healthcare Revolution: Transforming Medical Training at CHLA: https://www.youtube.com/watch?v54om8g0u9a4M
AR	A variation of VR—plays a supplemental role rather than a replacement of reality. AR combines digital and physical media by adding computer-generated imagery to everyday objects	See physical environment and virtual additions simultaneously	Head-mounted displays or projected displays	CAE VimedixAR with Microsoft HoloLens Augmented Reality: https://www.youtube.com/watch?v51-ks5aJveCU BodyExplorer: https://www.youtube.com/watch?v5T6G2OWJm5hs

the flexibility to represent individual and team dynamics. Learners can review the game content at will and set up episodic/chunked story-based narratives that fit periodic training timeframes. During game play, a computer uses AI and advanced algorithms based on player interactions to provide dynamic and unique game play. As technology evolves, it will be increasingly possible for AI to allow for more flexible rule structures, which provide a unique learning experience for the learner by allowing them to explore the game space, test hypotheses, and fulfill goals in a variety of different and unanticipated ways.[17]

Virtual Reality

VR is created using interactive software and hardware, and provides a realistic immersive simulation of a 3-dimensional environment that is experienced and controlled by body movements and/or hand controllers. The learner is transported into the immersive VR environment via a head-mounted apparatus that prevents the learner from perceiving any elements of the real world. According to Mantovani et al.,[18] the key features of a VR environment include 3-dimensional imaging and the ability to actively interact with visual and auditory feedback. The learner has a feeling of being directly part of the simulated experience and can interact with avatars and 3-dimensional objects. Stimuli from the virtual interactions dominate their perception and cognition. A quick Internet search reveals equipment commercially available.

Table 2. New Nurse Response to VR Education Compared With Traditional Training Methods

	Effectiveness of VR Simulation Training Versus Traditional Training		
Traditional Training Modality	**VR Less Effective**	**VR Equally Effective**	**VR More Effective**
Didactic teaching		15.4%	84.6%
Online learning			100%
Reading			100%
Bedside teaching	38.5%	53.8%	7.7%
Standardized patient encounters		61.5%	38.5%

Augmented Reality

AR is a variation of VR. AR plays a supplemental role rather than a replacement of reality. AR combines digital and physical media by adding computer-generated imagery to everyday objects to provide additional information about the object or environment to the learner. With AR, one can see the physical environment and the virtual additions simultaneously due to advanced position detection and environment mapping that can fill the surroundings with virtual images, objects, and programs.[19] The coexistence of virtual objects and real environments enables learners to visualize complex spatial relationships and abstract concepts.[20] The learner experiences events that are difficult to replicate in the real world,[21] allowing the learner to interact with both 2- and 3-dimensional synthetic objects and real-life objects.[22] Interacting with real-life and virtual objects, AR provides an avenue for the development of important practices and skills that cannot be developed and enacted in other technology-enhanced learning environments.[23]

PILOT STUDY: PRELIMINARY FINDINGS

The modality of immersive simulation is rapidly becoming one of the most significant teaching–learning–evaluation strategies available in nursing education.[24] Augmenting what they have learned, new nurses transitioning from academia to the practice setting are professionally developed through hospital-based programs. Nursing professional development practitioners are leading innovative approaches to facilitate learning in the practice setting. Transition to practice programs such as RN residency, orientation, and onboarding utilizing simulation may benefit from integration of AI modalities like VR and AR.

We are currently conducting a VR simulation education intervention in a controlled pilot study for new nurses (less than 6 months' clinical experience) within a large, academic medical center. The purpose of the study is to describe new nurse recognition of respiratory distress, change in the nurse learners' self-perceived level of expertise, and attitudes toward VR-based education.

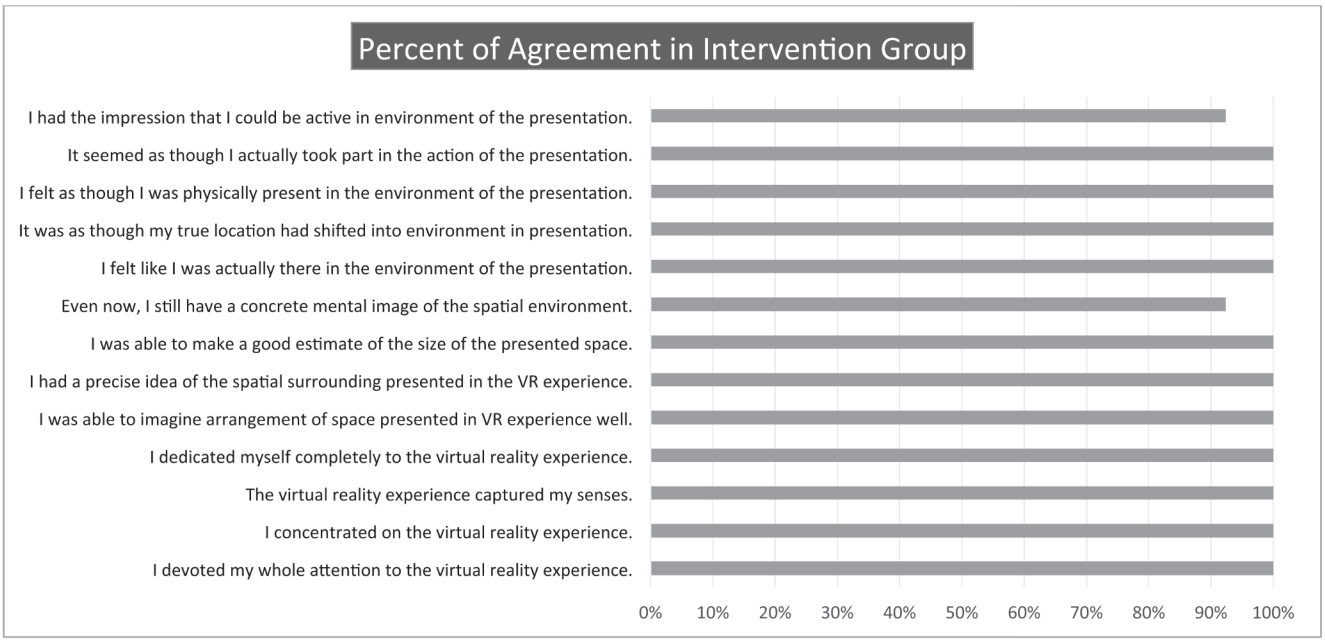
New nurses have been randomized into either an intervention or control group and have received standard training including didactic on respiratory assessment, equipment, and a case study. Only intervention learners received a 20-minute VR curriculum regarding clinical assessment of respiratory distress and independently complete study-related surveys following the VR curriculum.

At 3 and 6 months, all nurse learners (intervention and control) will complete a 15-minute follow-up session to assess the knowledge gained from the VR curriculum for the intervention group and the knowledge gained from the traditional training in the control group. That assessment will consist of 3 video vignettes that require nurse learners to assess the patient's respiratory status and the presence of impending respiratory failure.

Preliminary findings to date show we have enrolled 25 new nurses (13 in the intervention group; 12 in the control group) with 92.4% having less than 2 months' experience working in their unit. In the intervention group, prior to training, 92.4% rated their competency level of assessment of respiratory distress as a reporter (accurately gather clinical information of respiratory symptoms though have difficulties assessing the severity) (46.2%) or interpreter (accurately interpret the degree of respiratory distress) (46.2%). After training, 100% of the participants rated their competency level as either interpreter (46.2%), manager (develop management plans for a patient with respiratory distress) (38.5%), or educator (able to help or coach other nurse learners in assessing and managing respiratory distress) (15.4%).

New learner confidence, competence, and satisfaction have been remarkable. Preliminary data from the RN respondent's first training in the intervention group suggests that VR simulation training is more effective

Table 3. New Nurse Response to VR Education Intervention Experience



than other traditional teaching modalities with the exception of bedside teaching (*Table 2*). These are preliminary findings; thus, limitations include sample size and post-intervention findings at 3 and 6 months pending. Attitudes of the nurse learners' experience toward this VR-based education indicated that they felt the simulation was similar to the real-life environment and were wholly engaged in the process (*Table 3*).

SUMMARY

We have a moral imperative to respond to practice readiness gaps. Artificial intelligence, gaming, and VR offer an innovative approach to influence the cognitive development of clinical reasoning. Reducing new nurse turnover can decrease costs, combat nursing shortages, and improve patient outcomes. Recognizing, understanding, and acting upon factors influencing TPPP will be key to new nurse retention. AI technologies may be the catalyst for change to close this academic-practice gap. In today's culture, embracing AI technology in the learning environment may expedite nursing knowledge and transform the way in which our new nurses transition to practice.

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