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Innovations in Simulation

Designing Virtual Gaming Simulations

Margaret Verkuyl, MN, NP PHC^{a,*}, Jennifer L. Lapum, PhD, RN^b,
Oona St-Amant, PhD, RN^b, Michelle Hughes, MEd, RN^a, Daria Romaniuk, PhD, RN^b,
Paula Mastrilli, PhD, RN^c

^aSchool of Community and Health Studies, Centennial College, Toronto, Ontario, Canada

^bDaphne Cockwell School of Nursing, Ryerson University, Toronto, Ontario, Canada

^cSally Horsfall Eaton School of Nursing, George Brown College, Toronto, Ontario, Canada

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Abstract: Experiential learning is an important component of nursing education. Coupled with the limited opportunities to practice clinical skills in specialty areas and the pedagogical possibilities of virtual environments, our team started producing virtual gaming simulations. They incorporate an innovative pedagogical approach to simulation based on a branching scenario format. In this article, we share our experience in creating virtual gaming simulations with the aim to inspire other educators to engage in this technology-enabled, learning modality designed to enhance experiential learning among nursing students.

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There have been challenges in securing nursing student placements (CASN, 2010) in specialty clinical areas such as maternal and newborn in Ontario and throughout Canada (Smith, Corso, & Cobb, 2010). As a result, nursing students in undergraduate programs often have limited opportunities to practice skills in these specialty areas. This reality cannot be ignored, considering that clinical experiences offer an opportune time for students to apply what they have learned and advance their knowledge base. To address this concern and enhance existing curriculum, many nursing programs have incorporated in-person simulation in a laboratory setting and more recently virtual simulations. For the

purpose of this article, we define virtual simulation based on the terms of fidelity, immersion and patient, as a high-fidelity, 2D immersive simulation using videos of actors (simulated patients) in which the user can make clinical decisions for learning in health care (Cant, Cooper, Sussex, & Bogossian, 2019). Simulations offer a safe learning environment where students can apply nursing knowledge and reflect on their actions and decisions. However, the costs to operate and maintain medium to high-fidelity simulation laboratory experiences are high (Gates, Parr, & Hughen, 2012). In addition, scheduling and accessing laboratory space can be problematic, particularly for large programs that have upward to 500 students enrolled in each year. Although in-person simulations are valuable and help to prepare students for the clinical setting, students usually have

* Corresponding author: mverkuyl@centennialcollege.ca (M. Verkuyl).

only one opportunity to participate in a particular scenario. In contrast, virtual simulations provide the opportunity for repeating a scenario and can be completed from any location with access to the internet. In an integrative review, [Cant and Cooper \(2014\)](#) found web-based simulation provides learning benefits similar to in-person simulation approaches and the authors predicted that virtual simulations will have a major role in nursing curriculum. Virtual simulation design and production costs range between \$10,000 and \$50,000 (USD) ([Botezatu, Hult, Kassaye Tessma, & Fors, 2010](#)) with minimal yearly maintenance fees ([Verkuyl, Romaniuk, & Mastrilli, 2018c](#)). Once created, virtual simulations can be used repeatedly for years by unlimited cohorts of students at minimal cost

Key Points

- Nursing educators, with limited resources, can develop virtual gaming simulations.
- Sharing experiences advances the development of virtual gaming simulations.
- Working with a team of interdisciplinary members is crucial when developing virtual simulations.

([Lapum et al., 2018](#)).

Our team designed and produced virtual gaming simulations (VGS) that use a computer-based platform and educational gaming design to embody the learner as the clinician in a variety of scenarios. Over five years, we have improved our design and technique through usability and mixed methods studies, collaboration with technical experts in game design, and attention to nuances of student learning. Our team members have also provided guidance to groups of educators and health care professionals in creating their own VGS. This article is beneficial for educators who are seeking effective strategies to produce high-quality VGS. We will begin by describing our innovative game and then will share strategies for designing VGS.

Virtual Gaming Simulation

Virtual simulations provide an opportunity for immersive and experiential learning to promote critical reflection ([DeGagne, Oh, Kang, Vorderstrasse, & Johnson, 2013](#)). Through a combination of engagement and knowledge acquisition, virtual simulations trigger the learner's emotional connection with the client ([Foran, 2011](#); [Saunders & Berridge, 2015](#); [Verkuyl & Hughes, 2019](#)). These learning experiences are designed for learners to integrate their knowledge, apply it to a simulated clinical experience, and make clinical decisions in a safe environment ([DeGagne et al., 2013](#); [Verkuyl et al., 2017](#)). The ultimate benefit is preparing learners for real-life

clinical expectations by developing competencies needed for practice.

VGS, a type of virtual simulation, is based on an experiential teaching-learning approach that uses a computer-platform and is informed by both serious gaming and simulation pedagogies. Learners playing a VGS are actively involved in clinical situations that are intense, require the use of critical thinking skills, and involve risk, but do so within a learning environment that ensures they can test their clinical decision-making skills safely. Our approach to VGS creation uses filmed vignettes of clients, family members, nurses, and other health care providers acting out clinical situations. The clips are filmed from the nurse's point of view so that, the learner embodies the role of the clinician while playing the VGS, providing an authentic experience rather than an observation.

We use a branching scenario format, in which the narrative unfolds according to the learner's clinical decision-making while playing the VGS, allowing them to experience the consequences of their decisions. To start, the learner receives a prebrief describing the learning objectives, the case, how to play the game, and the computer technology required. Then, the first vignette sets up the simulation and stops at a decision point requiring the learner to select a course of action, mirroring a real-life clinical experience. If an incorrect selection is made, the learner is presented with a film clip that plays out the consequences of their decision. Then, feedback prompting the learner to reflect on the choice is provided, and the learner is given the opportunity to select a different response. If the correct response is selected, the learner sees the consequences of the correct decision and then moves to the next decision point. This process continues until the learner has successfully completed the game (see VGS at <https://de.ryerson.ca/games/nursing/hospital/>). The learner can repeat the VGS as many times as they choose. After the game, the learner receives a summary report outlining each correct and incorrect decision the learner made. Once the learner completes the VGS, self-debriefing questions are provided for the learner to reflect on their learning experience. The self-debrief is designed to evoke reflection on their assessment techniques, clinical decision-making, and best practices for future clinical situations.

Game Development

In this section, we share our learning from producing VGSs and strategies to help others who are considering using and creating simulations using technology-enabled formats. We are cognizant of the fact that higher quality translates to higher costs and at times a high-quality product is not required to meet the required learning outcomes, so in each section, we offer lower cost alternatives.

An important aspect in the development of virtual simulations is funding (Kilmon, Brown, Ghosh, & Mikitiuk, 2010). For us, both the university and the provincial government provided funding opportunities for open-access online learning resources that we were able to secure to produce several VGS. For most grants, we are given about 35,000.00 (CDN) to create one VGS with 12 decision points which take about 60 minutes to play. Botezatu et al. (2010) estimated the cost of virtual simulation design and production ranges between \$10,000 and \$50,000 (USD) (Botezatu et al., 2010) and then there are yearly minimal maintenance fees (Verkuyl, Romaniuk, et al., 2017). In our experience, it can take 6 to 9 months to create a VGS when faculty continue to fulfil their teaching and other academic responsibilities. When making the first virtual simulation, it would be prudent to document each team member's time so that future project funding can be evidence informed.

The design and production of VGS requires an interdisciplinary team that is able to capitalize on specific members' expertise (Lapum et al., 2018). Our team consists of nursing educators who collaborate with an interdisciplinary team of instructional designers, web developers, multimedia production editors, accessibility specialists, interactive design and audio-recording specialists, standardized patients, and support staff. To develop a common language and end goal, it is crucial to engage in discussion early in the design phase. Our interdisciplinary team meetings were scheduled at regular intervals throughout the game development process.

At the onset, it is imperative to identify the VGS purpose and expected learning outcomes (Lapum et al., 2018). Articulating the purpose and outcomes lays the foundation for script writing, decision points, and an end product that aligns with curricular learning objectives (Lapum et al., 2018). We set generic learning outcomes relevant to Canadian nursing programs, creating potential for global uptake. As a result, our VGS has been used by thousands of learners in four different countries. If the learning outcomes are overly tailored to a particular curriculum, the game becomes less accessible to learners outside that program.

Fidelity is integral in design decisions to enhance the realism of the experience. Realism is an important component to enhance engagement in digital mediums (Bouvier, Lavoué, & Sehaba, 2014) and to create a "suspension of disbelief" within simulation-based learning (Muckler, 2017). One strategy we use to enhance the VGS fidelity is filming actors in the scenarios instead of using avatars. The realness of an actor creates a life-like experience that resembles actual clinical practice. To add to the realism, we predominately used trained or professional actors. In addition, filming the scenario from a first-person point of view immerses the learner in the VGS because they are not only engaged as the nurse, but they are expected to make decisions from the nurse's perspective. To further enhance the realism, our filming is done by a professional

videographer and sound technologist, which results in a high-quality film to heighten immersion. A limitation to using actors and film professionals is the cost. A lower cost option would be to use a compact action camera like GoPro™ to film the scenarios. However, the limitations of the camera are the quality of the video, sound, and lighting. Instead of paying professional actors, costs can be contained by having nursing students or students in an acting program play certain roles. Inexperienced actors have the potential to increase filming time and decrease the realistic portrayal of the scenario. We have successfully recruited students and family members for specific roles in our VGS.

Another important strategy to heighten realism is to create an effective narrative that enhances learner engagement by prompting curiosity, connectivity, arousal, and social connection (Bouvier et al., 2014). To develop and refine the narrative in our games, we have a team of three to four nurse educators develop the script and decision points, which are shared with content experts (nurses currently working in the specific specialty) for their feedback. The educators use this feedback to revise the scripts. The revised scripts are forwarded to the web developer and videographer, who then meet with the nurse educators to read through the script, with team members taking on the various roles. This step is crucial because the verbal articulation of the lines and rehearsed interaction allows us to modify the scripts to enhance its realism. Reading the scripts aloud helps to identify where colloquialisms should be added or where jargon should be removed. The scripts are then shared with the actors and a dry run is completed before the filming takes place. During the dry run, minor wording changes are made. This iterative approach to script development takes time, but ultimately decreases the length of filming and increases the impact of the scenario, as a realistic narrative facilitates learners' engagement and connection to the characters on a cognitive, emotional, and visceral level (Verkuyl et al., 2017). In addition, the filming location is an important one, we found selecting a shooting location that is quiet and free of background noise and has appropriate lighting saves time by preventing filming delays.

Game design features are integral to developing a VGS that learners will want to play. Our web designer created a user-friendly, customizable software platform that was easily adopted and user friendly for educators and students. Gaming elements are infused into the platform to enhance motivation, knowledge retention, engagement and critical thinking (Cooper, Cant, Bogossian, Kinsman, & Bucknall, 2015). In our VGS, we gamified the simulation through character development and storylines, whereby the learner became invested in the outcome of events. The learners were also scored during or at the end of the game, which creates competition and engagement. Other gaming elements that could be used include completing timed activities and acquiring badges. The contributions of our web designer have been essential to the success of our games. However, recognizing that the costs of hiring a web

developer can be prohibitive, an alternative would be to use a software platform, which has already been developed for creating branching simulations, such as H5P™ or Articulate™. These platforms are easy to use, designed well, and create an effective final product.

Finally, evaluation is an important component to creating these experiences. Technological challenges exist with all virtual experiences and will impact learners' and educators' experiences. The first two VGS created by our team went through usability testing with both nursing students and educators before embedding it into the curriculum. This step is often overlooked when developing technology-enabled resources but is crucial for successful uptake and optimal engagement. The technology acceptance model by Davis (1989) was used to inform the studies which looked at two factors: ease of use and perceived usefulness. The study's results were used to enhance ease of use, and participants indicated a high level of perceived usefulness for the VGS (Verkuyl, Atack, Mastrilli, & Romaniuk, 2016; Verkuyl, Romaniuk, & Mastrilli, 2018c). When the VGS was implemented into our curriculum, students who experienced technology-related problems were directed to contact faculty, who would then contact the development team. Providing numbers to call for technology support will decrease faculty and student frustration when using this modality.

Critical examination of outcomes provides the basis for including the virtual simulation and making delivery changes. A research plan helped us to evaluate the inclusion of the virtual simulation in our curriculum. A few examples of the studies we conducted to assess learning with baccalaureate nursing students include the following. We conducted studies comparing in-person simulation to virtual simulation looking at self-efficacy, knowledge, and satisfaction and found comparable outcomes (Verkuyl, Romaniuk, Atack, & Mastrilli, 2017). Another study (Verkuyl et al., 2017) used focus groups to examine the students' experience using the VGS and found positive outcomes related to satisfaction, high levels of engagement, enhanced knowledge, and self-efficacy. These positive outcomes have also been found in a study with registered practical nurses in bridging to baccalaureate nursing programs (Verkuyl & Hughes, 2019). Finally, we are exploring debriefing formats following a VGS that optimizes the learning experience (Verkuyl, Atack, McCulloch, Lui, Betts, et al., 2018a; Verkuyl, Lapum, Hughes, McCulloch, Liu, et al., 2018b). Evaluation is ongoing and requires careful consideration in planning new initiatives, as we learn from our previous work.

Conclusion

The shift to using VGS in the context of technology-enabled platforms is an exciting opportunity for educators

to be part of and influence their production. Working in collaboration with an interdisciplinary team enhances the fidelity and impact of a high-quality VGS. Sharing our experience enables other educators to join into this innovative pedagogy.

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