Chapter 15
Technology Enabled Learning in Nursing

Diane J. Skiba

Abstract Over the last decade, technology enabled learning has thrived in the health care professional education arena. This is particularly true as the rise of disruptive technologies has greatly impacted not only education but also the delivery of health care across the globe. Thus, it is immensely important that nurses use a variety of digital tools to provide learning experiences that will best prepare for health care professionals to practice in a digital health ecosystem. In this chapter, the goal is to highlight examples of technology-enhanced learning and to prepare nurses for a technology-enhanced practice within a digital health ecosystem.

Keywords Computer based simulations · Immersive virtual simulations · Virtual reality · Online learning · Connected health digital tools · Virtual visits

Over the last decade, technology enabled learning has thrived in the health care professional education arena. This is particularly true as the rise of disruptive technologies has greatly impacted not only education but also the delivery of health care across the globe. Thus, it is immensely important that nurses use a variety of digital tools to provide learning experiences that will best prepare for health care professionals to practice in a digital health ecosystem. In this chapter, the goal is to highlight examples of technology-enhanced learning and to prepare nurses for a technology-enhanced practice within a digital health ecosystem.

Electronic Supplementary Material The online version of this chapter (https://doi.org/10.1007/978-3-030-58740-6_15) contains supplementary material, which is available to authorized users.

D. J. Skiba (✉)
College of Nursing, University of Colorado, Aurora, CO, USA
e-mail: Diane.Skiba@CUAnschutz.edu

P. Hussey, M. A. Kennedy (eds.), *Introduction to Nursing Informatics*, Health Informatics, https://doi.org/10.1007/978-3-030-58740-6_15

Learning Objectives for the Chapter

1. Identify technology tools that will enable you to learn about nursing and health care.
2. Describe the use of virtual clinical simulations to master nursing knowledge, skills and attitudes.
3. Describe the concept of connected health and its impact on the healthcare environment.
4. Identify digital health care tools that patients, families, consumers and caregivers will use now and in the future.
5. Assess your current and future role as a nurse in the digital health ecosystem.
6. Understand that as a nurse, professional development, particularly in the area of informatics, is important.
7. Understand that consumers are becoming more engaged in their care and are using many digital tools to manage their health.
8. Understand that clinical practice requires collaboration with nursing informatics specialists to provide safe quality patient centric care.
9. Consider that digital health tools will continue to influence your nursing practice now and in the future.

15.1 Introduction

The term technology enhanced learning has various definitions. "The term, Technology-enhanced learning (TEL), is used to describe the application of technology to teaching and learning. It is a broad category that isn't particularly defined, but, in short, TEL is any technology that enhances the learning experience." (Cullen 2018). In some instances, digital education is "the innovative use of digital tools and technologies during teaching and learning, and is often referred to as Technology Enhanced Learning (TEL) or e-Learning." (University of Edinburgh Institute for Academic Development 2018). The bottom line is how technology can foster learning.

The use of technologies to facilitate and enhance the learning experience is the focus of this chapter. The exploration includes both existing and emerging technologies. As a learner, you may be exposed to some of these technologies in your formal educational program or you may experience these technologies as part of your professional development opportunities. Regardless, it is important for all nurses to have a broad understanding of the various digital tools as they will be part of your nursing practice now and in the future.

15.2 Simulations

The use of simulation is a predominate method of teaching nurses. In the beginning, simulation consisted of the use of a manikin. The original manikin, Mrs. Chase, was developed in 1911 and was first used by Hartford Hospital Training School in

Connecticut (Hermann 1981). Mrs. Chase and her accompanying family were fixtures in numerous nursing schools across the globe for over 60 years. These simulation manikins were incorporated into nursing education as a major teaching method to prepare students for clinical practice in a safe learning environment. In the late 1950s and 1960s, new manikins such as Resusci-Anne and Sim One were introduced. New dimensions, such as heartbeats, breathing and patient responses to intravenous drugs, were now included in the simulation manikins. "With improvements in technology, more tasks and clinical skills could be simulated." (Harder 2009).

High fidelity simulators, that mimic human responses, continue to be used in nursing schools across the globe. In addition, standardized patients has been introduced into nursing curriculum. "Standardized patients (SPs) are trained actors who portray patients in realistic clinical interview and physical examination scenarios used in health professions education." (Brender et al. 2005, p. 1172). SP are used to teach a variety of nursing clinical competencies. Here are a few examples. Andrea and Kotowski (2017) have used SPs to teach undergraduate nursing health assessment skills that included interviewing a patient and taking their health history. Sarmasoglu, Dinc and Elcon (2016) used SPs for nurses' psychomotor skill development taking blood pressures and subcutaneous injections. At the graduate level, SPs have been used in nurse practitioner education (Gibbons et al. 2002). According to Shin et al. (2019, p. 19) "high fidelity simulators and standardized patients have a demonstrable impact on enhancing learner's performance skills and metacognitions." However, labor time and costs associated with high fidelity simulations, SPs development and implementation (Shaikh et al. 2017) and growth of online education has prompted the need to find alternative simulation strategies. Technological advances, including the rise of the Internet have served as a catalyst for these alternative simulation strategies.

15.3 Computer-Based Virtual Simulations

According to Cant et al. (2019, p. 27) "Computer-based simulation may include virtual worlds, virtual environments, virtual patients, virtual reality task trainers, and serious games." In some cases, the term virtual reality is used to describe learning experiences. Bell (2008, p. 2) uses the term, virtual reality simulations to mean "a synchronous, persistent network of people, represented as avatars, facilitated by networked computers." In this section, examples of various types of virtual simulations are given. The goal is to familiarize you with various technologies as they are not only used for education of nurses but are also being used to educate and engage patients.

One of the most common computer based simulations are virtual patients. Virtual patients "are interactive computer simulations of real-life clinical scenarios for the purpose of healthcare and medical training, education, or assessment." (Ellaway et al. 2008, p. 170). Padilha et al. (2019) described the use of virtual patients on a

computer touchscreen for nursing students in Portugal. In this particular case, students used a clinical virtual simulator called Body Interact. This simulator program uses physiologic algorithms as a basis of the virtual patient. The student is able "to interact with the virtual patient through dialogues, monitoring of physiological parameters, observation and physical examination, the prescription and/or analysis of complementary examinations, and the prescription of intervention and/or pharmacological treatment." (Padilha et al. 2019, p. e11529). At the end, there are two options for closure of the case: successful resolution or amount of time that has lapsed. The student's performance in terms of clinical reasoning is assessed and feedback is provided.

In Sweden, virtual patients were used to assess clinical reasoning for nursing students. Fosberg et al. (2011) conducted a pilot study to assess student feedback about using virtual patients as a part of their distance-based classes. Virtual patients were designed using Web-SP (Web-based Simulation of Patients). This particular software program "was initially developed at Karolinska Institutet (Zary et al. 2006) and used worldwide at several universities in health care educations. Based on the feedback from students as they interacted with the virtual patients, it was determined that virtual patients alongside self-evaluations provided an assessment of their clinical reasoning skills development. This team continued the development and use of virtual patients for their undergraduate students. Most recently, Forsberg et al. (2019) conducted a qualitative study to train nursing students to develop clinical reasoning and support active students participation. Student received lectures and then were assigned virtual patients to assess, identify health problem and the nursing care needed. Based on their analyses, the team concluded "that use of the VP cases helped the students to broaden their thinking, which improved their ability to draw conclusions and their problem-solving ability when obtaining a comprehensive view of the patient." (Forsberg et al. 2019, p. 1480).

Peddle et al. (2016) conducted an integrative review of virtual patients and nontechnical skills of undergraduate health care professionals. In their study, nontechnical skills were defined as "the cognitive, social and personal resource skills that complement technical skills and contribute to safe and efficient task performance." (Flin et al. 2008, p. 1). Twenty eight studies met their criteria and were deemed of sufficient quality. The majority of the studies were from the United States with other studies emanating from Australia, Sweden, United Kingdom, Iran and the Netherlands. Studies were examined using a thematic analysis. The first theme indicated that virtual patients were used in a variety of ways to teach, reinforce, practice, build confidence with communication skills. It was also noted that it was useful in developing verbal and non-verbal communication skills. A second theme centered on teamwork. This included developing team skills and team communication skills. It was also used to clarify roles and promote interaction plus collaboration with team members. There were a smaller number of studies that represented the following themes: decision-making, socialization into professional role, transfer of knowledge to clinical setting, and authenticity.

Virtual patients are important technology enabled learning experiences for not only nursing students but would be beneficial to practicing nurse who may be taking

care of patients. This could be particularly true for nurses who may be practicing in new nursing units or transitioning from a medical surgical unit to oncology care.

Another example was the development of a virtual gaming simulation (VGS). Verkuyl, Romaniuk, Atack and Mastrilli (2017) developed a computer based game where students were asked to provide care for a pediatric post-appendectomy recovery. Video clips of the patient and their mother provided a background for the case. Students were able "to collect assessment data, make intervention decisions, and experience the consequences of their choices as they care for the child and his mother." (Verkuyl et al. 2017, p. 240). Students were assessed using a pediatric Skills Self-Efficacy tool.

15.4 Immersive Virtual Simulations

These simulations allowed learners to become immersed in a health care environment and interact with avatars. The avatars represented patients, family members and in some cases other health care professionals. According to Shin et al. (2019) integrative review, Second Life was the most common platform used for virtual reality simulations. One example is the use of a virtual pediatric primary care clinic in Second Life used to teach family nurse practitioners (Cook 2012). This system allowed learners to practice clinical decision making by interacting with avatars representing child and their parent. Learners could access the patient's medical and family history, medication and allergies list as well as other pertinent patient information.

Schaffer et al. (2016) used Second Life to teach public health to RN degree completion students. Faculty created several different virtual environments for their students. One was an opportunity for students to triage victims of a plane crash at a chemical plant. They were also able to visit a Women's & Children Clinic & Adolescent Health Clinic to conduct family assessments and to visit an elderly woman in her home to conduct a home safety assessment.

At the University of Kansas, a virtual assisted living center, Jayhawk Community Living Center (JCLC), was created to allow informatics students to create a fall-risk management system (Manos and Modaress 2020). Learners were given a request for a proposal to develop the system. Their first task was to meet with the Director of Nursing avatar (a faculty member) to determine system requirements. The learners were responsible for taking a tour of the clinic to process system requirements and generate any questions. The learners were responsible for several deliverables such as use cases, storyboards and workflow diagrams. Learners in their database theory course also used the JCLC to create a database for the fall-risk assessments.

At the University of Colorado, Second Life was used by a variety of graduate students who were enrolled in online courses. As part of their interprofessional education, students in nursing and pharmacy were engaged in assessing and treating patients in the CU Virtual Health Hospital/Clinic. Virtual Clinic/Hospital consists of: "clinical exam rooms for observation and interaction; medical surgical unit

patient rooms; a psychiatric unit with sound proof walls; pharmacy; medical records room; patient registration; a nursing station; an auditorium for grand rounds; numerous administrative offices; and conference rooms complete with whiteboards for brainstorming, poster board for presentations, a presentation wall for PowerPoint slides or streaming videos, and web access for students to use during their clinical conferences." (Skiba et al. 2014, p. 59). Learners created their own avatars and interacted with avatar patients and other health care professionals. For example, psychiatric nurses interacted with an adolescent and her mother. The adolescent suffered from a bipolar disorder and was having difficulties with the side effects of her medication. In this case scenario, the nurse practitioner did a video consult with a pharmacist to adjust the medication regime (Figs. 15.1 and 15.2).

The University of Colorado also used Second Life In the graduate nursing informatics program. Graduate students used Virtual Hospital/Clinic to complete a

Fig. 15.1 This is a picture of the entrance to the University of Colorado Virtual Hospital in Second Life

Fig. 15.2 This picture shows an Interprofessional Team meeting with patient in University of Colorado Virtual Hospital in Second Life

system life cycle project. Students were assigned to teams and were required to select and implement either a bar code medication administration system or a decision support system. As a collaborative team assignment, students used Second Life to meet together, interview key health care professionals and to assess system environments. In one year, students from Colorado, Lebanon and New Zealand, met in Second Life to make decisions about project planning, system analysis tasks, writing a Request for Proposal, making a final system selection and designing an implementation and evaluation plan for their project (Danforth et al. 2012).

15.5 Virtual Reality Devices

For some learning, it was necessary to have virtual reality devices to become immersed in the environment. There are several different types of virtual reality devices. The most common is a head mounted device or VR headset. There is also a headset that is available for use with a smartphone. These devices allow one to become immersed in the environment and are sometimes accompanied by other devices such as haptic tools or treadmills. The popularity of VR headsets used by gamers has helped to make devices affordable for not only academic environments but also for use of VR in clinical settings. VR is used in various clinical setting for: pain management, minimizing fear and anxiety for children in the hospital, provide a distraction for certain procedures such as injections or for chemotherapy infusions. What follows are some examples of VR devices being used in nursing education.

For a graduate course in nursing leadership, virtual reality experience was designed to allow a team to summit Mount Everest. The immersive environment, Everest 2, required a computer based simulation and a VR headset. Students selected various roles in the simulation: "team leader, team doctor, photographer, marathoner, environmentalist, and an optional observer." (Aebersold et al. 2020, p. 2). In their evaluation of this experience, students feedback was categorized into three themes: communication, team dynamics and success or failure. The authors concluded that there was potential to use immersive virtual reality to provided realistic simulated experiences for students.

Jenson and Forsyth (2012) described the use of a virtual reality device along with a haptic arm device to teach nurses how to insert and intravenous catheter. The students used a computer based program to select items such as equipment, cleaning the site and starting the insertion. The haptic arm device was connected to the computer and the student could palpate the arm and then virtually insert the catheter. This experience made use of three dimensional graphics and provided students with a simulated environment to feel vascular access.

At Vanderbilt School of Nursing, nurse practitioners students use a virtual headset to "master competencies in the use of ultrasound technologies."(Weiner et al. 2019, p. 893). The team developed this virtual reality using a immersive VR authoring system called Cenario VR. The software creates both photo and videos into an

immersive learning environment. The learner wears a VR headset which allows them to participate directly in the experience. The study concluded that "VR offers one solution to expand the teaching-learning environment." (Weiner et al. 2019, p. 896).

A recent study, Ball and Hussey (2020) examined the effects of augmented reality on anxiety level of nursing students. According to the Interaction Design Foundation (2020), "Augmented reality (AR) is a view of the real, physical world in which users find elements enhanced by computer-generated input. Designers create inputs ranging from sound to video, to graphics to GPS overlays and more, in digital content that responds in real time to changes in the user's environment, usually movement." In their study (Ball and Hussey 2020) used a type of AR, 360 degree photosphere, to orient students for their first clinical site before they began their clinical practicum at maternal child clinical setting. The goal was to prepare students for this rotation and to lower their anxiety about this first clinical experience. With cooperation from the clinical site, the university team built this 360 degree photosphere. This augmented reality experience was uploaded to a secure web site for all students to access prior to their clinical rotation. In this study, student were randomly assigned to either a control group (instructor-led orientation) and the experimental group (AVR). Students were given pre and post tests to measure their anxiety using the State Trait Anxiety Test. Although no statistically significant differences were found between the two groups on the anxiety measure, the team concluded there was still value in using this technology. The value was that it presented a consistent orientation to the clinical setting whereas there could be differing faculty presentations about the clinical setting.

Another example of augmented reality device is the use of Google Glasses to teach nursing students. At Duke University, students using Google Glass watched a video of a car accident in which the victim was having difficulty breathing. As the student watched the video, they had to deliver care to a manikin representing this victim. "The video of the patient was played in each student's field of vision to augment the clinical changes the manikin was programed to display. The intent was for the patient in the video to show in real time what the manikin was displaying." (Chaballout et al. 2016, p. 2). At the University of Miami, faculty could use their laptop and telehealth software to watch a student perform an intubation. According to Foronda et al. (2020), "The software synced the telehealth glasses to the computers so that faculty could see in real time the vantage of the student on their laptops. The faculty directly observed the students performing the intubation and provided verbal instruction to guide and assist students through the simulated intubation of a manikins."

15.6 Online Learning

A major component of TEL is the availability of online learning. Over the past twenty years, online learning has evolved from a novel experience to a standard in higher education. The growth of online learning has increased yearly and offers nurses formal education and professional development learning opportunities,

formal education. Early examples of online learning typically mimicked the classroom environment. Early online courses were fairly passive learning consisted of: recorded lectures, quizzes and tests and a discussion board.

As the technology for offering online course progressed and course management systems were designed, there were many schools experimenting with different learning strategies in the online environment. Faculty began to minimize lectures and begin to engage the student in their own learning. The shift was from a passive learning to a more active learning environment. In these early days, some faculty followed principles designed to foster learning. These principles, *Seven Principles for Good Practice in Undergraduate Education* (Chickering and Ehrmann 1996) were adapted for use in web-based courses. Billings et al. (2001) adapted these principles and established a benchmarking project, Evaluating Educational Uses of the Web in Nursing (EEUWIN). This project spanned three different universities and was focused on graduate education being offered for nurse practitioners, acute care clinical specialists and informatics students. As part of this benchmarking project, teaching and learning strategies were shared to increase the overall effectiveness of individual courses. As a member of this project, the University of Colorado College of Nursing enhanced their online graduate healthcare informatics Master's degree program.

In the last decade, online learning flourished with the introduction of emerging technologies to allow both synchronous and asynchronous learning. Nursing education has embraced online learning and offered many online learning degree programs for RN-BSN completion learners, graduate students earning their master's or doctoral degree.

As new technologies became available, more online learning incorporated technology tools to foster:

- communication (blogs, twitter, video conferencing, real time discussion groups)
- teamwork and collaboration (google docs, Slack, BaseCamp, Dropbox)
- data visualization (Tableau, Google Charts, Infogram)
- knowledge creation (whiteboards, mind maps)
- social interactions (Facebook journal clubs, Instagram, Vimeo)
- animation (Adobe Character, Animaker, Moovly, Polygon)

Online learning was not limited to text only content materials with web link but now incorporates a variety of multimedia such as You Tube videos, podcasts, animations and infographics. Students were now using these multimedia tools to complete homework assignments.

15.7 New Models of Education

Also in the last decade, society entered into the Connected Age with development of the Internet of Things (IOT) and more connectivity via mobile technologies. The IOT "is the latest evolution of network-aware smart objects that connect the physical world with information." (Johnson et al. 2012, p. 30). As a result of this

evolution, two transformations occurred in academia and in health care. The first was the development of new models of education for the connected age. In healthcare, there was a subsequent transformation to an era of connected health. What does connected mean?

> Connecting is about reaching out and bringing in, about building synergies to create a whole that is greater than the sum of its parts. Connecting is a powerful metaphor. Everyone and everything—people, resources, data, ideas—are interconnected: linked and tagged, tweeted and texted, followed and friended. Anyone can participate. (Oblinger 2013, p. 3)

Online learning had now new models to guide the development of courses and program. Connected learning fostered new ways for connecting people with resources, experiences and communities.

> With connected learning, the idea is to connect-the-dots: to connect learning with life." Connected learning is engaging, customized, flexible, affordable, accessible, and lifelong. The connections enable the construction of pathways that can guide learners and institutions. (Oblinger 2013, p. 4)

Online learning no longer was promoting a passive learning environment but an active learning environment. Learners were now given opportunities to create their own learning pathways in an online course. At the University of Colorado, we created learning guides for students in their online courses. Courses were designed in a modular format and each module focused on an in depth guide to a particular content area. The learning guides was tailored for those students new to the field of informatics and those that were already practicing in the informatics field. Thus, based on your existing knowledge and experience with the topic at hand, learners created their own learning pathway to achieve learning outcomes.

Other universities also created online learning opportunities that incorporated social media such as Facebook for journal clubs and twitter and blogs for student discussion groups. Other schools of nursing experimented with online polling via smartphones. Kouri et al. (2017) highlighted examples of the use of social media in health education. They noted that tools such as Google Scholar were useful for nursing research, YouTube for creating multimedia presentations for class assignments and LinkedIn to begin to establish a professional nursing network. They also described how Savonia University used student blogs. Each student created their own personal learning environment using both a blog to document their learning experiences and the WhatsApp for communication and collaboration within their learning environment. Procter (Proctor et al. 2016) shared an example of their virtual exchange designed to provide learning opportunities across three countries (United Kingdom, United States and New Zealand). In this project, a closed Facebook group was established and undergraduate students participated in discussions related to population health.

During this transformation time, higher education also witnessed the development of the Massively Open Online Courses (MOOCs) movement. According to Educause (2020), a MOOC "**is a model for delivering learning content online to virtually any person**—and as many of them—who wants to take the course".

> MOOCs can involve thousands of students. The structure tends to be asynchronous and flexible to accommodate the varying levels of participation. Anyone can participate for free in any or all of the course's learning activities (e.g. discussions, blogs, video lectures, other social media tools). While there may not be feedback from the instructor, chances are there will be lots of discussion form all open participants. (Skiba 2012, p. 416)

Throughout the next few years, numerous MOOCs were developed by many universities in a variety of disciplines including health care. Learners from across the globe participated in MOOCs. "Like most innovations, MOOCs passed through Gartner's (2017) hype cycle … and fell into Gartner's trough of disillusionment. With interest in creating MOOCs subsiding, some universities did not reap the benefits of offering the free online courses they developed." (Skiba 2017, p. 291). To renew the interest in MOOCs, the model was adapted to move toward sustainability and profitability. There still exists some free MOOCs but other business models have evolved and include charges for grading and certificates of completion or a subscription model with fees.

The major MOOC providers include:

- Coursera (https://www.coursera.org/)
- EdX (https://www.edx.org/)
- FutureLearn (https://www.futurelearn.com/).

15.8 Connected Health

With the advent of the connected age, higher education was not alone in their transformation. The connected age also impacted health care and spurred the development of Connected Health. Caulfield and Donnelly (2013, p. 704) were one of the first to define it as

> Connected Health encompasses terms such as wireless, digital, electronic, mobile, and telehealth and refers to a conceptual model for health management where devices, services or interventions are designed around the patient's needs, and health related data is shared, in such a way that the patient can receive care in the most proactive and efficient manner possible. All stakeholders in the process are 'connected' by means of timely sharing and presentation of accurate and pertinent information regarding patient status through smarter use of data, devices, communication platforms and people.

Their position was that it was not just technology that was promoting connected health but it was the rise of consumerism. More and more people were engaging in their healthcare through the use of mobile applications, access to patient portals and consumer products like blood pressure monitoring equipment. Connected health represented a transition from telemedicine and e-health concepts.

More recently as the digital world became more popular in society, the term has evolved into Digital Health. In 2019, The World Health Organization noted that

> The term digital health is rooted in eHealth, which is defined as "the use of information and communications technology in support of health and health-related fields". Mobile health

> (mHealth) is a subset of eHealth and is defined as "the use of mobile wireless technologies for health". More recently, the term digital health was introduced as "a broad umbrella term encompassing eHealth (which includes mHealth), as well as emerging areas, such as the use of advanced computing sciences in 'big data', genomics and artificial intelligence. (WHO 2019)

More recently, the Health Information Management Systems Society (HIMSS) on 2 March 2020 published the following definition of digital health as

> Digital health connects and empowers people and populations to manage health and wellness, augmented by accessible and supportive provider teams working within flexible, integrated, interoperable and digitally-enabled care environments that strategically leverage digital tools, technologies and services to transform care delivery. (Snowden 2020) (https://www.himss.org/news/himss-defines-digital-health-global-healthcare-industry).

Given the rise in digital health, it is incumbent on nursing education to ensure future and current nurses are prepared to practice in this digital health era. Numerous countries have recognized the need to prepare nurses to practice in a digital health ecosystem. In some countries, the nursing association were responsible for setting the agenda to prepare nurses for the digital era. In other cases, individual schools of nursing were preparing the nursing workforce through both formal education or professional development programs. Here are a few examples across various countries.

- In Finland, The Finnish Nursing Association developed the *eHealth Strategy of the Finnish Nurses Association 2015–2020* (https://sairaanhoitajat.fi/wp-content/uploads/2020/01/eHealth_RAPORTTI-_ENGLANTI.pdf).
- In the United States, the National League for Nursing released a statement, *A Vision for The Changing Faculty Role: Preparing Students for the Technological World of Health Care* (http://www.nln.org/docs/default-source/about/nln-vision-series-(position-statements)/a-vision-for-the-changing-faculty-role-preparing-students-for-the-technological-world-of-health-care.pdf?sfvrsn=0). In this document, they made recommendations to Administrators, Faculty and to their organization on how to incorporate more teaching and clinical experiences to prepare current nursing students about digital health, in particular tools related to consumer engagement, data analytics/visualization and virtual health.
- The Royal College of Nursing in the United Kingdom developed a campaign, *Every nurse an e-nurse*, to prepare nurses for their digital health roles (https://www.digitalhealth.net/2017/08/nhs-digital-endorses-every-nurse-an-e-nurse-campaign/) and in 2017, there was the launch of the NHS Digital Academy (https://digital.nhs.uk/about-nhs-digital/careers/the-academy-at-nhs-digital) in 2017 to prepare leaders to promote the NHS's digital transformation.
- In Canada, a national survey was conducted to describe the current state of the inclusion of digital health content in the nursing education curriculum. It also identified exemplars of digital health integration (https://www.casn.ca/wp-content/uploads/2019/06/SoN-Final-Report-EN.pdf). The study identified there was a gap in teaching nurses about digital health across schools of nursing. They also found educators taught "about the use of technology for teaching and learning as

opposed to the technologies used specifically in the delivery and management of health care services." (Nagel et al. 2018, p. 6). Another interesting finding was that educators felt because students were computer literate, they were therefore also digital health literate.

- In New Zealand, Honey et al. (2020) conducted a study to develop nursing informatics competencies specific within the context of their country. The result was the development of Guidelines for Nursing Informatics Competencies for Undergraduate Nurses in New Zealand (https://auckland.figshare.com/articles/Guidelines_Informatics_for_nurses_entering_practice/7273037)
- More recently, The Australian Digital Health Agency (ADHA) conducted a survey to "identify the necessary digital health capabilities for nurses and midwives to further improve the quality, safety and efficiency of care (https://www.hisa.org.au/nurses-and-midwives-framework/).

Here are some examples of schools of nursing incorporating digital health education in their curriculum.

- Drake and Leander (2013) described the use of a social network (NING) to engage community health students across 11 different nursing schools in an online assignment. The assignment was for students to watch a video, "In Sickness and in Wealth" and engage in guided discussions related to their understanding of health disparity.
- Jackson, Getting and Metcalfe (2018) described how nursing students at the Florence Nightingale Faculty of Nursing, Midwifery & Palliative Care at King's College London were encouraged to use Twitter to share the most pertinent and key messages from presentations given at a nursing conference. The exercise helped students to engage in the appropriate use of social media to share ideas within the nursing community.
- Ross and Myers (2017) described a social networking project in which students from two countries connected with each other to learn about cultural competence. The students were given opportunities to connect via Facebook, wikis, blogs and Skype.

The University of Colorado has implemented various learning activities for all graduate students to learn more about digital health. These learning opportunities provide them with experiences to use and evaluate various digital health tools. Here is an example:

> Patient Portal Exercise: Students are sent a patient portal email asking for help in seeking a website, a social network to join and a mobile application to manage their new diagnosis of epilepsy. Student received the email and access to the patient's electronic health record and their last two health visit summaries. The student must use evaluation criteria to assess an appropriate web page, social network and a mobile application. They then response to the patient's email.

Students may also take a course, Digital Tools for Connected Health

- Emoji assignment: Students are asked to propose a plan to facilitate the use of emojis to interact and monitor students with a particular chronic disease.

- Evaluation of a mobile app: Students are asked to select a mobile application from the Veterans Administration Mobile Applications Store (https://www.mobile.va.gov/appstore/). They download the free m-app and then using evaluation criteria to assess the application.
- Visit different web sites (such as https://aflacchildhoodcancer.org/ or https://www.ces.tech/Topics/Health-Wellness/Digital-Health.aspx) related to innovative consumer digital tools and determine their potential in clinical environments and for consumer engagement.
- Digital Health Campaign-Create a video campaign that highlights the benefits and challenges of a digital health tool for a designated patient population or nursing staff.

15.9 Virtual Visits with Patients

As health care institutions begin to embrace digital health, there has been a greater acceptance of virtual patient visits. The coronavirus pandemic served as a catalyst to offer patients the opportunity to have a virtual patient visit. Using secure video conferencing system available for desktop, tablets or smartphones serve as the platform for these virtual visits. In some cases, the virtual visit may be initiated by a virtual assistant (chatbot) that will seek pertinent information from the patient before connecting the patient to their health care professional. Here are some different examples of how faculty are preparing nurses to participate in virtual patient visits.

Grady (2011) was a pioneer in the development of a virtual practicum for nursing students. Students enrolled in an Associate degree program course on the management of adult patients with complex health needs. Students from this rural area conducted patient visits via telehealth video conferencing. The patients were at a military base hospital in another state. The telehealth connection allowed for visits with the patients and joining with the health care team as they discussed the particular patient and their health care needs.

Merritt, Brauch, Bender and Kochuk (2018) developed a web-based simulation to teach nurse practitioner student to conduct an e-visit. Students were introduced to virtual patients and had the ability to interact with the patients by selecting questions. Responses to their questions were recorded voice over patient responses. The student conducted the e-visit by identifying the appropriate diagnosis and documenting a management plan including prescriptions and pertinent patient education.

Erickson, Fauchald and Ideker (2015) created a telehealth experience for their nurse practitioner students. The students first received training in conducting a telehealth visit and were then assigned a 4 hour clinical to conduct telehealth visits. Using a video conferencing system, students connected with off-site telehealth provider and with their patients. Students were allowed to observe and interact with the patient and the provider during the visit.

At the University of Colorado, family nurse practitioners students teamed with a pharmacy student to conduct a virtual visit with a standardized patient (Skiba

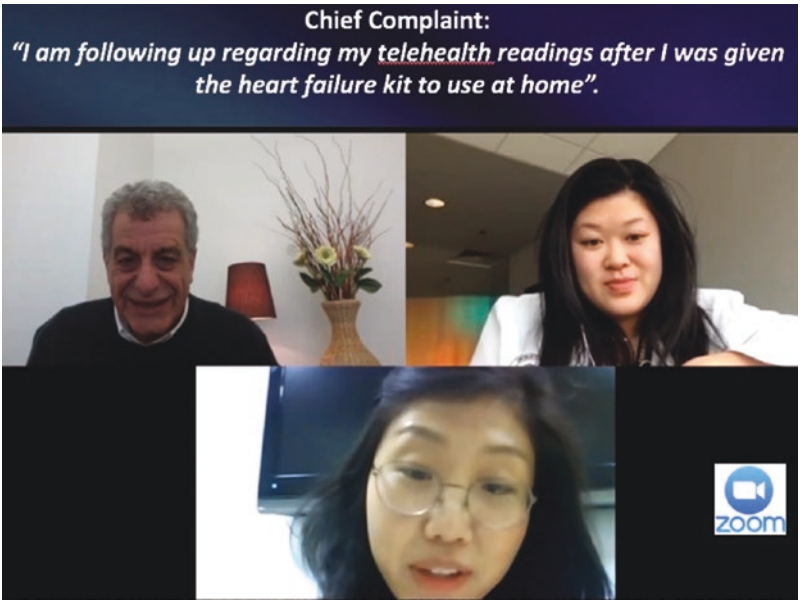

Fig. 15.3 A three-way virtual patient visit with a nurse practitioner student, a pharmacy student and a standardized patient

et al. 2016). The standardized patient was trained to use the video conferencing system and also how to use a variety of digital health tools. The standardized patient was a 74 year old man who has a follow up visit with his health care team after being discharged from the hospital with his heart failure kit for use at home. This heart failure kit included the following digital health tools: Digital Stethoscope, Pulse Oximeter, Wireless Blood Pressure Monitor & Smart Body Weight Analyzer. Students evaluated the experience as being valuable and it prepared them to participate in virtual visits in their professional roles (Estes et al. 2016) (Fig. 15.3).

15.10 On the Horizon

As we look to the future, the digital ecosystem will continue to expand with the use of more smart tools. As Sarasohn-Kahn noted "the new front door for healthcare will be the patients' home front door." (Sarasohn-Kahn 2018). Patients will have access to numerous digital health tools and massive amounts of data to facilitate their health care decisions (Skiba 2018a). These digital tools will include wearable smart devices, mobile apps, robots and virtual assistants. Healthcare will witness the intersection of data, devices and artificial intelligence that will lend itself to the concept of an invisible health care professional (Skiba 2018b). This invisible health

care professional may be a virtual chatbot using artificial intelligence to determine a diagnosis or help with the management of chronic health conditions. As these technologies become commonplace in our health care ecosystem, nurses will need additional preparation to interact and care for future patients, families and caregivers.

15.11 Summary

As a nurse either starting their career or currently a nurse in practice, it is of utmost important for you to become a technology enabled nurse. There is a need for all nurses to develop competencies that allow them to practice in a digital health ecosystem. Nurses will encounter the use of virtual simulations in their practice when they are introduced to new or complicated patients. Nurses will be using virtual reality devices with their patients and assigning patients to complete virtual simulations to understand more about their particular health care issue. Nurses will need to manage a deluge of patient data from digital health tools and understand data analytics and data visualization. Nurses will need new communication and engagement skills to provide virtual care to patients in their homes as well as interacting with virtual assistants and chatbots. Preparing yourself for the digital health ecosystem will enable the technology enabled nurse will become a valuable asset within the digital health ecosystem.

Review Questions

1. In your clinical practice, how might you/a health care team use immersive clinical simulations to continue to develop your clinical expertise?
2. You are serving on a hospital quality improvement committee, you are interested in increasing your knowledge about quality improvement. What online learning opportunities are available to you?
3. To gain a better understanding of the responsibilities of a technology enabled nurse, this video lecture will introduce you to a patient, Josephine, recently discharged from the hospital and how digital tools are helping her recovery at home (https://youtu.be/EjletAiz1_8). The video starts with the description Internet of Things (IOT) and the concept of connected care. You will meet Josephine and see how she was using digital health tools through her inpatient care and also when she was discharged. Here are some questions:

   (a) What digital health tool was being used when she was receiving inpatient care? How was she using this tool during her inpatient stay? How will this tool going to impact your nursing role?
   (b) What digital health tools was she given upon discharge? What are the pros and cons of these tools?
   (c) Where can you seek advice for recommending digital health tools for your patients?

Answers

1. Here are some examples of how your health care team might use a virtual simulation. You are providing care for a Covid-19 patient who has underlying conditions such as pulmonary hypertension. Your education program can program a virtual case scenario and your team could interact with this virtual patient to develop a plan of care. You could also use a virtual reality device to practice your skills in preparing yourself with Personal Protective Equipment (PPE). Using a virtual reality device to better understand the process of intubation and Ventilation to explain to your patient's family.
2. Here are some examples of how you can increase your professional knowledge. You can do a google search and find the Institute for Healthcare Improvement and see they have open courses as well as a wealth of online resources. You can go to Coursera and find the following MOCCs that are available: Leading Healthcare Quality and Safety (George Washington University), Take the lead on healthcare quality improvement (Case Western Reserve University) Patient safety and quality improvement: Developing s systems review (Johns Hopkins University) or go to FutureLearn and find Quality Improvement in Healthcare: The case for change (University of Bath) and Making Change in a healthcare environment (University of East Anglia)
3. Here are the responses for the case study

   (a) Josephine is given a tablet in the inpatient setting. This tablet provides here with access to her interprofessional health care team, view her health assessment, patient goals and treatment plan. She is also able to develop her own personal health goals and can access health care educational materials.
   (b) Josephine is given a digital stethoscope, pulse oximeter, blood pressure monitor and digital weight scale. The advantages are the patients will be able to monitor herself in between virtual visits with her health care provider. Her family will also be able to see her progress. Data can also be transmitted to her health care provider to alert them if there is a health issue that needs attention. Some issues may be that the patient lacks access to the Internet, does not have the digital literacy to use the tools and issue of who pays for the access to these digital health tools. Security and privacy issues may also be of concern.
   (c) I can contact the nursing informatics specialists at my hospital or the health care informatics office.

Glossary

Computer-based simulations Virtual environments, created digitally, in which students can engage in scenarios to mimic real life situations and complete tasks designed to enhance their learning

Connected health Healthcare that is inclusive and utilizes digital health technologies

Enhanced learning Teaching and learning using a variety of digitally-mediated technologies

Online learning Active learning using digital technologies to engage with course content, peers, and faculty in a dynamic manner

Virtual visits Health care encounter between a provider and client using digital or virtual platforms

References

Aebersold M, Rasmussen J, Mulrenin T. Virtual Everest: immersive virtual reality can improve the simulation experience. Clin Simul Nurs. 2020;38:1–4. https://doi.org/10.1016/j.ecns.2019.09.004.

Andrea J, Kotowski P. Using standardized patients in an undergraduate nursing health assessment class. Clin Simul Nurs. 2017;13:309–13. https://doi.org/10.1016/j.ecns.2017.05.003.

Ball S, Hussey L. The effects of augmented reality on prelicensure nursing students' anxiety levels. J Nurs Educ. 2020;59:142–8.

Bell MW. Toward a definition of "virtual worlds". J Virtual Worlds Res. 2008;1:1–5.

Billings D, Connors H, Skiba D. Benchmarking best practices in nursing web-based courses. Adv Nurs Sci. 2001;23:41–52.

Brender E, Burke A, Glass RM. Standardized patients. JAMA. 2005;294:1172.

Cant R, Cooper S, Sussex R, Bogossian F. What's in a name? Clarifying the nomenclature of virtual simulation. Clin Simul Nurs. 2019;27:26–30. https://doi.org/10.1016/j.ecns.2018.11.003.11.

Caulfield B, Donnelly S. What is connected health and why will it change your practice? QJM. 2013;106:703–7. https://doi.org/10.1093/qjmed/hct114.

Chaballout B, Molloy M, Vaughn J, Brisson R III, Shaw R. Feasibility of augmented reality in clinical simulations: using google glass with manikins. JMIR Med Educ. 2016;2:e2. https://doi.org/10.2196/mededu.5159.

Chickering AW, Ehrmann SC. Implementing the seven principles: technology as lever. Amer Assoc High Educ Bull. 1996;49:3–6.

Cook MJ. Design and initial evaluation of a virtual pediatric primary care clinic in second life. J Am Acad Nurse Pract. 2012;24:521–7. https://doi.org/10.1111/j.1745-7599.2012.00729.x.

Cullen E. What is technology enhanced learning. Interactive blog. 10 September 2018. https://www.mentimeter.com/blog/interactive-classrooms/what-is-technology-enhanced-learning-and-why-is-it-important. Accessed 5 April 2020.

Danforth C, Condon T, Deforest R, Marini A, Al AZ. Informatics students across the globe learn to collaborate in second life. In: Abbott P, Hullin C, Nagle L, editors. Studies in informatics: advancing global health through informatics. Proceedings of the NI2012. The 11th international congress of nursing informatics. American Medical Informatics Association: Bethesda, MD; 2012. p. 376–80.

Drake M, Leander S. Nursing students and Ning: using social networking to teach public health/community nursing in 11 baccalaureate nursing programs. Nurs Educ Persp. 2013;34:270–2.

Educause. MOOCs: seven things you should know about MOOCs. https://library.educause.edu/resources/2011/11/7-things-you-should-know-about-moocs. Accessed 5 April 2020.

Ellaway R, Poulton T, Fors U, McGee J, Albright S. Building a virtual patient commons. Med Teach. 2008;30:170–4. https://doi.org/10.1080/01421590701874074.

Erickson C, Fauchald S, Ideker M. Integrating telehealth into the graduate nursing curriculum. J Nurs Pract. 2015;11:e1–5.

Estes K, Gilliam E, Knapfel S, Lee C, Skiba D. Discovering eHealth technology: an innovative interprofessional graduate student learning experience. In: Weber P, Seremus W, Proctor P, editors. The 13th international nursing informatics congress. Leiden: IOS Press; 2016.

Flin R, O'Connor P, Crichton M. Safety at the sharp end: training non-technical skills. Cornwall: Ashgate Publishing; 2008.

Foronda C, Crenshaw N, Briones L, Snowden K, Griffin M, Mitzova-Valdinov G. Teaching and learning the skill of intubation using telehealth glasses. Clini Sim Nurs. 2020;40:31–5.

Forsberg E, Georg C, Ziegert K, Fors U. Virtual patients for assessment of clinical reasoning in nursing—a pilot study. Nurs Educ Today. 2011;31:757–62. https://doi.org/10.1016/j.nedt.2010.11.015.

Forsberg E, Bäcklund B, Telhede EH, Karlsson S. Virtual patient cases for active student participation in nursing education—students' learning experiences. Creat Educ. 2019;10:1475–91. https://doi.org/10.4236/ce.2019.107108.

Gartner. Gartner hype cycle. 2017. www.gartner.com/technology/research/methodologies/hype-cycle.jsp. Accessed 5 April 2020.

Gibbons S, Adamo G, Padden D, Ricciardi R, Graziano M, Levine E, Hawkins R. Clinical evaluation in advanced practice nursing education: using standardized patients in health assessment. J Nurs Ed. 2002;41:215–21. https://doi.org/10.3928/0148-4834-20020501-07.

Grady J. The virtual clinical practicum: an innovative telehealth model for clinical nursing education. Nurs Educ Persp. 2011;32:189–94.

Harder N. Evolution of simulation use in health care education. Clin Simul Nurs. 2009;5:e169–72.

Hermann E. Mrs. chase: a noble and enduring figure. Am J Nurs. 1981;81:1836.

Honey M, Collins E, Britnell S. Education into policy: embedding health informatics to prepare future nurses—New Zealand case study. JMIR Nurs. 2020;3:e16186. https://doi.org/10.2196/16186.

Interaction Design Foundation. Augmented reality. https://www.interaction-design.org/literature/topics/augmented-reality. Accessed 5 April 2020.

Jackson J, Gettings S, Metcalfe A. "The power of twitter:" using social media at a conference with nursing students. Nurs Educ Today. 2018;68:188–91. https://doi.org/10.1016/j.nedt.2018.06.017.

Jenson CE, Forsyth DM. Virtual reality simulation: using three-dimensional technology to teach nursing students. Comput Inform Nurs. 2012;30:312–8.

Johnson L, Adams S, Cummins M. The NMC horizon report: 2012 higher education edition. Austin, TX: New Media Consortium; 2012.

Kouri ML, Rissanen P, Weber P, Park H. Competencies in social media use in the area of health and healthcare. In: Murphy J, Goossen W, editors. Forecasting informatics competencies for nurses in the future of connected health. Leiden: IOS Press; 2017.

Manos E, Modaress N. A paradigm shift in simulation: experiential learning in virtual worlds and future use of virtual reality, robotics and drone. In Saba V, McCormick, K (editors). Essentials of nursing informatics. 2020,

Merritt L, Brauch A, Bender A, Kochuk D. Using a web-based e-visit simulation to educate nurse practitioner students. J Nurs Educ. 2018;57:304–7.

Nagle L, Kleib M, Furlong K. Study of digital health in Canadian schools of nursing: curricular content and nurse educator capacity. A report of the findings-2018. Canada Health Infoway and Canadian Association of Schools of Nursing. 2018. https://www.casn.ca/wp-content/uploads/2019/06/SoN-Final-Report-EN.pdf. Accessed 5 April 2020.

Oblinger DG. The connected age for higher education is here. Are we ready for the future? EDUCAUSE Rev. 2013;48:4–5.

Padilha JM, Machado PP, Ribeiro A, Ramos J, Costa P. Clinical virtual simulation in nursing education: randomized controlled trial. J Med Internet Res. 2019;21:e11529. https://doi.org/10.2196/11529.

Peddle M, Bearman M, Nestel D. Virtual patients and nontechnical skills in undergraduate health professional education: an integrative review. Clin Simul Nurs. 2016;12:400–10. https://doi.org/10.1016/j.ecns.2016.04.004.

Proctor P, Brixey J, Honey M, Todhunter F. Social media and population health virtual exchange for senior nursing students: an international collaboration. In: Weber PW, Seremus W, Proctor P, editors. The 13th international nursing informatics congress. Leiden: IOS Press; 2016.
Ross J, Myers S. The current use of social media in undergraduate nursing education: a review of the literature. Comput Inform Nurs. 2017;35:338–44.
Sarasohn-Kahn J. Healthcare comes home at CES. 2018. https://www.huffpost.com/entry/healthcare-comes-home-at-ces-2018_b_5a553760e4b0e3dd5c3f8cec. Accessed 5 April 2020.
Sarmasoglu S, Dince L, Elcon M. Using standardized patients in nursing education: effects on Students' psychomotor skill development. Nurs Ed. 2016;41:e1–5.
Schaffer M, Tiffany J, Kentack K, Anderson L. Second life virtual learning in public health nursing. J Nurs Educ. 2016;55:536–40.
Shaikh F, Inayat F, Awan O, Santos M, Choudhry A, Waheed A, Tuli S. Computer-assisted learning applications in health educational informatics: a review. Cureus J Med Sci. 2017;9:e1559.
Shin H, Rim D, Kim H, Park S, Shon S. Educational characteristics of virtual simulation in nursing: an integrative review. Clin Simul Nurs. 2019;37:18–28. https://doi.org/10.1016/j.ecns.2019.08.002.
Skiba D. Disruption in higher education: massively open online courses (MOOCs). Nurs Educ Persp. 2012;33:416–7.
Skiba D. What has happened to massively open online courses? Nurs Educ Persp. 2017;38:291–2.
Skiba D. Consumer electronic show 2018: a focus on digital health tools. Nurs Educ Persp. 2018a;39:194–5.
Skiba D. The invisible health care professional: exploring the intersection of data, devices and artificial intelligence. Nurs Educ Persp. 2018b;39(4):264–5.
Skiba D, Barton A, Knapfel S, Moore G, Trinkley K. Infusing informatics into Interprofessional education: the iTEAM (interprofessional technology enhanced advanced practice model) project. In: Saranto K, Weaver C, Chang P, editors. East meets west: eSMART. Proceedings of the 12th international congress on nursing informatics. Leiden: IOS Press; 2014.
Skiba D, Barton A, Estes K, Gilliam E, Knapfel S, Lee C, Moore G, Trinkley K. Preparing the next generation of advanced practice nurses for connected care. In: Weber P, Seremus W, Proctor P, editors. The 13th international nursing informatics congress. Leiden: IOS Press; 2016.
Snowden A. Health information management systems society (HIMSS). HIMSS defines digital health for the global healthcare industry. 2020. https://www.himss.org/news/himss-defines-digital-health-global-healthcare-industry. Accessed 5 April 2020.
University of Edinburgh Institute for Academic Development. What is digital learning? 2018. https://www.ed.ac.uk/institute-academic-development/learning-teaching/staff/digital-ed/what-is-digital-education. Accessed 5 April 2020.
Verkuyl M, Romaniuk D, Atack L, Mastrilli P. Virtual gaming simulation for nursing education: an experiment. Clin Simul Nurs. 2017;13:238–44. https://doi.org/10.1016/j.ecns.2017.02.004.
Weiner E, Gordon J, Rudy S, McNew R. Expanding virtual reality to teach ultrasound skills to nurse practitioner students. In: Ohno-Machado L, Seroussi B, editors. Health and wellbeing e-networks for all. Proceedings of the 17th world congress on medical and health informatics; 2019.
WHO. WHO guideline: recommendations on digital interventions for health system strengthening. Geneva: World Health Organization; 2019.
Zary N, Johnson G, Boberg J, Fors UG. Development, implementation and pilot evaluation of a web-based virtual patient case simulation environment-web-SP. BMC Med Educ. 2006;6:10. https://doi.org/10.1186/1472-6920-6-10.