CONTINUING EDUCATION

Contextualizing Instructional Technology to the Demands of Nursing Education

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This article reviews current technologies in nursing education and the impact of technology on learning. The integration of technology into nursing curricula is thought to improve efficiency and enhance student experiences through active learning and interactive learning designs. The following focused questions are explored: (1) What are the current technologies used by university students and faculty in nursing programs? (2) How does that technology influence student learning? The primary themes were student-centered technology, with five subthemes, and faculty-centered technology. Consumers of healthcare (patients) demand quality care and expect highly skilled, compassionate, ethical practitioners; to this end, training and education of future nurses by skilled, qualified nurse educators who are comfortable with technological demands of all aspects of healthcare are fundamental. While it is essential that nurses and nurse educators continue to publish as a mechanism for open discussion and transparency in our teaching and learning approaches, we need higher levels of evidence to strengthen the argument that technology improves the learning environment and student outcomes and has a positive impact on clinical settings and patient care.

KEY WORDS: Instructional technology, Nursing education, Technology-enhanced learning

Since 2000, technology use has grown exponentially as a result of new devices, smaller batteries, and novel and innovative applications to assist in all aspects of life and living. Smart homes, phone applications for home security, home cleaning, televisions, and much more are becoming a way of life. It is no surprise that technology is taking a strong hold in the educational setting and the classroom. From tablets for e-books, to clickers for real-time responses from students, to online delivery systems, technology is changing the face of education. Educators, education administrators, information technology (IT) support professionals, and students have been affected by the influx of diverse forms of technological innovations. The trade association Comp TIA stated that technology makes learning fun, prepares students for the future, improves retention of content material in students, assists students to learn at their own pace, and affects how educators teach, deliver content material, and evaluate student learning.[1]

Most higher education institutions and nursing programs today integrate technology into curriculum. This integration has been found to improve efficiency in the delivery of education and enhance the student experience. Sandars[2(p537)] cited several aspects of educational design important to successful integration of technology in teaching and learning, notably "the learner, the content to be provided, the instructional design to ensure that learning can be maximized, the technology to deliver the experience, and the context in which the new experience will be implemented." Williamson and Muckle[3(p70)] documented that other factors worth assessing are "cost, compatibility, technical issues, and the culture of the organization."

Technological advances have been used to address clinical placement shortages,[4] faculty shortages,[4] student access to educational opportunities through technology-enhanced learning (TEL) programs (rural, underserved regions),[5] and program and course delivery methods for all levels of nursing education.[4]

A historical review is presented to illustrate the use of technology by professional nurses and how the evolution of technology affects learning, pedagogy, nurse educator roles, and expected student outcomes (Table 1). Nursing education has evolved and adapted to student expectations, institutional resources, community stakeholder expectations (employers), and healthcare trends. With the increased availability of technology, it is necessary to consider the consequences of dependence on technology when systems fail. Security and cost are two major areas of concern within technology. Cyberattacks and hacking of technology systems is no longer science fiction. It is a reality that leads to concerns about secure data and space, encrypted systems, and questions about electronic surveillance by government and other agencies. These concerns, along with increasing costs of new technology, add to the

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Table 1. Evolution of Technology, Learning, and Teaching Styles in Nursing Programs

Decade	Technology	Learning Style: Student-Teacher Relationship	Setting/Environment	Outcomes/Evaluation
1970s Traditional	Face-to-face classroom style, low technology, textbooks, TV, limited computer use for research, typewriters, programmed instruction costs prohibitive to students; limited IT and tech support	Teacher as "sage"[6,7]	Classroom	Paper-and-pencil assignments and exams
1980s	Same as above + Web-enhanced instruction to supplement didactic instruction	Same as above; beginning investigations of learning styles as significant in student preparation (Kolb's theory of experiential learning),[8]	Classroom	Same as above
1990s	Same as above, except computers more available, distance education using "postal mail", email and conferencing emerging	Same as above	Classroom	Same as above
2000 Paradigm shift in technology.	Distance education, computers, scantrons, AMS learning systems, CD-ROM, DVD, learning management systems: Tegrity, Blackboard, WebCT; limited mobile devices-wireless networks	Same as above: use of Internet and course platforms[9,10]	Physical setting beginning to change. Shift from level 1 pedagogy of engagement to level 2 andragogy (cultivation of self-directed learning)	Peer support through discussion boards and other institutional approved learning management systems
2005	Same as above with Web-based, synchronous and asynchronous curricula being utilized; clickers, smartphones, computers; PDAs. Increased need for IT and tech support for students and faculty. Slide presentation software for content delivery	Faculty as Sage being reexamined	Physical setting can be anywhere; mobile faculty environment Hybrid course deliveries with limited use. Some online programs for RN-to-BSN, Master's in Nursing/Family Nurse Practitioner programs. Heutagogy (self-determined learning) emerging as a "holistic approach to developing learner capabilities".[11]	Peer support through discussion boards; learner-directed methods adopted. Student autonomy being recognized
2010	Increased scientific advances (battery, storage power, memory, and functionality resulting in 10-fold production, accessibility and use of mobile IT. Same as above; costs more accessible to students. Use of ARS or clickers reported in literature.[12]	Faculty as "guide or facilitator"; peer support; students as mentors[2]	Mobile faculty environment[11], hybrid course deliveries—Web based: synchronous/asynchronous	Students increased confidence in use of technology in personal learning and patient care; anxiety and stress reduction. Learner autonomy required. Active learning and engagement
2015–2019	Fitbits,[13] smartphones, iPads, social media, AMS; videoconferencing; Skype; BlackBoard Collaborate and other platforms; mobile devices[14]	Same as above. Self-directed learning; flipped classroom designs[15]	Web-based may utilize more faculty developed videos to augment content delivery. PowerPoint with voiceover capability; students can link in from any setting	Students initiate when they engage in learning, self-paced, self-determined learning, variable environments for learning
2020 and beyond	New technologies in health information, patient care, decision making, and daily activity monitoring[16]	New learning theories	Innovative settings	Requiring evidence to support the safety and value of technology in learning environment and patient care settings

layers of considerations that must be addressed, whether educational institutions directly invest in learning management systems or they pass the expense along to students as a required part of their educational experience.[16] The purpose of this article is to review current technologies in nursing education and the impact of technology on student learning.

METHODS

A literature review method addresses the focused questions: (1) What are the current technologies used by university students and faculty in nursing programs? (2) How does that technology influence student learning? The Education Resources Information Center (ERIC) and MEDLINE databases were searched using various iterations or combinations of technology* AND nurs* AND education*, classroom, nursing education. Using the terms "technology and nursing education" yielded 155 results from ERIC and 120 articles from MEDLINE covering the last 10 years. Thirty-two articles focused specifically on undergraduate nursing education. Four articles not identified in the MEDLINE search were selected from ERIC based on availability, English language, and relevance to the topic. The search was extended to develop background synthesis of the evolution of technology specific to nursing education pedagogy. Using the terms "technology AND classroom" yielded 46 articles from 1973 to 2018. Sixteen articles were selected based on availability, English language, and relevance to the topic with dates from 2009 to 2018. The search was limited to scholarly research articles, published in the last 10 years. The focus is on undergraduate nursing education in the literature review, recognizing that many institutions use the same technology for their graduate nursing programs. The search was narrowed specifically to didactic learning but acknowledged the corresponding role that technology has in clinical education settings. Technology is defined broadly in this article, which does not provide a comprehensive review on any one specific tool or modality. As a result, 21 articles were selected for this literature review that encompass student and nurse educator technology trends in didactic learning. Two articles were found that addressed the role of leadership and institutional support in nursing education. The articles were then grouped into three content-focused areas: student-centered technology, faculty-centered technology, and institutional-centered technology.

RESULTS

Nine peer-reviewed data-based research articles were examined that focused on nursing student learning outcomes using TEL and reported perceptions of technology use in the classroom. Eleven articles were reviewed that focused on faculty initiating technology in the classroom, and two review and expert opinion articles were examined as they pertained to the role of the institution in nursing education and technology support. The literature reviewed is organized by three main themes: student-centered technology, faculty-centered technology, and institutional-centered technology. The first theme has five subthemes related to student learning, student success, and student outcomes. Three subthemes were identified for faculty centered-technology, and five subthemes were noted for institutional-centered technology.

Student-Centered Technology

Students often come to their educational setting with a skill set in specific technologies that can enhance or be applied to their educational journey. Students today expect to enroll in programs that are fully engaged with technology.[2] However, with the diversity of students now enrolled in undergraduate and graduate nursing programs and the array of technology available, institutions must address a broad range of students' adaptability, flexibility, and proficiency with educational technology.[17] Several factors emerge from the literature for consideration when tailoring technology to students' educational and professional needs.

Student Demographics

The use of technology in education has allowed for enrollment of more diverse nursing students who may not be able to complete traditional programs due to constraints related to the demands of work, supporting families, and time management.[2] Sandars[2(p535)] explained that the majority of learners are considered "digital natives [who] are high users of technology in their daily lives, but this is mainly restricted to mobile devices and Web 2.0 technology, especially the use of social networks and media sharing sites." As a result, there is an underlying assumption that these students can easily adapt to modes of educational delivery and learning tools.[14] It is not safe to assume that these learners are equally proficient with educational technology because, for example, students may not have had the financial access to devices or may be older students pursuing a second career.[3,12] Therefore, support must be available for students to orient themselves and adjust to delivery methods and tools.[9,18–22] Institutions must evaluate whether the level of support needed to integrate specific modes of technology into curricula can be met. Consideration of cost especially applies to integrating mobile technology in nursing education, as college students may be able to afford to use their mobile devices for only basic functions.[23]

Institutions should consider the specific demographics of enrolled students, including prior experience with technology, gender, and age.[9,19,24] These demographics can differ across prelicensure, RN-to-BSN, master's, and doctoral programs, which poses a challenge to institutions in accommodating those various learners.[17]

Student Satisfaction and Perceptions

Students' attitudes and overall satisfaction with technology are widely cited throughout the literature as critical to the success of educational programs.[3,19,24,26] Clark et al[18(p92)] found that "the degree to which faculty and students adopt technology is closely linked to the quality of support and design services available." This is a challenging barrier to overcome as the mismatch between faculty, clinicians, and students in terms of attitudes and perceptions around technology is consistent in the literature.[19,20] For example, while mobile technology may be encouraged by academic programs, students have reported hesitation to use mobile technology in clinical settings, as "staff and patients assumed they were using the device for personal reasons when in fact they were reading about a condition or medication they were dealing with at the time."[19(p125)]

Institutions and programs must consider faculty and clinical staff support for students to adopt educational technology when evaluating which tools and modes of delivery to incorporate.[19] The success of integrating technology and nursing education and students' future use of technology can be hindered if faculty are unwilling to serve as role models and accept the use of specific equipment and tools.[20]

Learning and Professional Outcomes

Integrating technology in nursing education has been beneficial to student learning outcomes related to research,[9] creativity,[17] clinical practice,[18] bridging the gap between theory and practice,[12] evidence-based practice,[19] and enhancement of professional skills.[20,24] Even in midwifery programs, technology, such as simulation, "presents the opportunity to demonstrate a number of variations and deviations from normal."[26(p11)] These outcomes are a critical determinant to the creation of specific learning experiences through intentionally designed delivery methods. For example, simulation is an excellent method to build students' proficiencies in clinical skills in a prelicensure program, but it may not be as necessary for doctoral programs for practicing nurses. No singular mode of technology could successfully address all learning outcomes for nursing education, so it becomes essential for institutions to make a balanced selection of a set of tools.

Several issues arise with nursing student education. Classroom attendance and participation/engagement are an ongoing faculty concern even when "attendance" is defined liberally for hybrid or online course delivery methods.[27–31] Telford and Senior[31] examined e-learning within a flipped classroom design to provide a positive learning experience for nursing students (N = 265). Their mixed-methods design reported perspectives from student who participated in an e-learning interactive teaching module with a flipped classroom approach. Students reported five factors that were positive in their learning experience such as flexibility, variety, student-focused, relevance, and evidence-based resources. Negative factors or challenges in this learning design were limited face-to-face encounters, insufficient feedback mechanism, and non-engagement of students within the e-learning design.[31] Green and Schlairet[30] noted similar themes (N = 14) in their qualitative study on flipped classroom heutagogical (self-determined or autonomous) learning, but participants in their small qualitative study reported higher rates (50%) of negative feelings about the flipped classroom experience. The authors explained that this was the first time students had experienced a "flipped" classroom, and it may be that shifting to this design may take time to adapt to differences in learning expectations.[30] Heutagogical practice is often associated with distance education and course delivery approaches.[32] Audience response systems (ARSs) or clickers are being used for classroom questioning (CQ) (another form of measuring engagement and participation). Mahon and colleagues[28] conducted a small study (N = 68) that examined students' attitudes toward ARS. Students noted that CQ helped them to learn (85.7%) and that it was fun (71.4%).[31] Students also noted they needed more time to answer the questions. Those who did not respond (82%) stated that they needed clarity of the question yet did not ask the instructor for clarity, and many students did not want to bother with responding or were waiting for others to respond. Filer[27] conducted a pilot study (N = 90) on the use of clickers in increasing student knowledge, motivation, and comfort in the classroom. Overall, student perceptions and attitudes were favorable with χ^2 significance noted in three domains: increased participation, comfort, and motivation. The author concluded that clickers offered a safe environment for learning and facilitated active learning.[27] Toothaker[15] found similar positive results reported by students (N = 99) in her mixed-methods approach to using clickers in the classroom. Gallegos and Nakashima[29] used iPads as their technology to engage students (N = 58) in active learning activities during a weekly 3-hour class session. Students (72%) reported that the use of iPads increased overall engagement during class discussions and enhanced their learning (89.7%). Students did note that unfamiliarity with the technology was a drawback.[29]

Technology-enhanced learning is the focus of Swart's[33] study. Addressing critical thinking instruction and TEL, 43 second-year nursing students were followed for one term. Overall, TEL strategies that were integrated into the curriculum were found to develop critical thinking as evidenced by online discussion postings. Students also reported appreciation of the use of technology in both their in-class and online learning activities.[33]

Undergraduate and graduate nursing programs should consider incorporating curriculum around technology in the nursing profession (electronic patient records, information management, innovative techniques for patient care) to better prepare students for the future of the nursing

workplace.[3,11] Even though this recommendation has been issued by several professional organizations,[20] not all programs consistently and intentionally design curricula around professional expectations of nurses in the workplace with technology.[11]

Confidentiality

While all institutions must consider the ramifications of decisions regarding student confidentiality and compliance with the Family Educational Rights and Privacy Act (FERPA), nursing education has the added factor of ensuring adherence to HIPAA policies for patient confidentiality. This is particularly relevant to the integration of technology into clinical education, as "patient confidentiality can be compromised if nursing students use nonapproved applications during care."[20(p665)] Regarding FERPA compliance, allowing students the freedom to choose which collaborative tools to utilize for assignments and projects protects the institution from any issues with confidentiality.[34] The rationale is that these files are not considered as educational records until they are in possession of the institution. However, if a tool is required, the institution has a responsibility to configure settings or use third-party utilities that secure the domains, online environments, and tools utilized. For example, new activity wrist devices such as product manufactured by Fitbit, Inc, with recent versions permitting alerts for text messaging and phone calls, may allow students to text faculty in classroom settings when learning occurs at multiple sites across a state or region. When instructional learning utilizes video conferencing (technology) and when there are problems with the technology, students at remote sites may contact the instructor to alert to those problems. This has the benefit of minimizing interruptions, but the disadvantage of putting the student in a position of sharing personal information via non–institutional-approved (firewall protected) modalities.

Mandatory Versus Optional Technology

Mandating the use of specific educational technology runs the risk of negative perceptions by students who may want to use tools more suitable to their learning styles, inhibiting creativity and motivation.[9,18] Providing multiple methods of instruction allows students the freedom to work from their preferences, yielding more positive results related to learning outcomes.[12,17] Mobile technology addresses this issue efficiently through the development of mobile apps; however, O'Connor and Andrews[12(p142)] cited that while "the widespread availability of standard software packages for mobile devices is welcomed… it sacrifices the possibility of developing and tailoring mobile applications for the specific needs of nursing students."

Faculty-Centered Technology

New methodologies and pedagogies for delivering education have changed how nursing content is delivered to students. No longer are faculty expected to only be proficient in nursing content, but the office computer's software such as Word, Excel, PowerPoint, statistical analyses programs, institutional learning management systems, and so on; instructional design; Web-based applications; and open online resources are now commonplace in the classroom. Over the last 10 years, students arrive with a vast knowledge of technology and expectations for their educational experience.

Faculty Perceptions of Students' Technology Competencies

Over the past 10 years, faculty concerns and perceptions of students' technological skills and competencies have been noted to increase in both theory and clinical courses, going from students embracing technology but perhaps having educationally disadvantaged and nontraditional students reporting more problems[35] to having the broad range of generations (Baby Boomers, Generation X, Millennial, or Net generations) who come to their educational settings with various preferences for use of technology in their nursing education experiences.[36] As a result, faculty need to be proficient in technologies that are used by students and supported by their institutions.

Faculty Expertise With Technology

Faculty have varying levels of comfort, training, and experience with different technology. Regardless of experience and proficiency, faculty still report challenges with how fast educational technology changes over time.[37] Charrier[38] expressed the need for leadership support to increase competency with faculty's education and training with technology. Hagler et al[37] found that adequate training and successful implementation of educational technologies can also result in enhanced faculty understanding of instructional design and best teaching practices. Faculty who are inherently driven to use technology outside of the educational role are much more likely to include this in their classroom teaching. This variance creates discrepancies in the delivery of nursing education. Gone are the times when faculty have a choice about integration of technology. Nurse educators are obligated to provide students with education that matches clinical practice.[39] Curan[40] used a formal faculty development initiative as a venue to increase faculty learning of technology and informatics competencies to better enhance the student clinical practice environment. This 3-year project resulted in faculty building a community of learning for themselves, as well as identification of faculty champions to sustain the momentum of learning and integration of technology in the classroom.[40]

Technology to Support or Enhance Learning

Students need exposure to technology in order to prepare for nursing practice.[38] A comprehensive knowledge of digital technology can play a vital part in patient safety. Students

who are exposed to a variety of technological innovation are more confident and can meaningfully use these technologies in their clinical practice. As many nurses struggle with technology due to difference in generations and consequent exposure to technology, students with this high level of exposure are well suited to become the experts in the clinical setting.[39] Several subthemes emerged under this category: technology to ease strain on limited resources,[41] technology to improve student learning outcomes,[36,42] technology to engage students,[15,25,43] technology as an educational pedagogy, and TEL.[12]

Institutional-Centered Technology

Institutions are faced with the challenges of providing teaching and learning environments that meet the needs of multiple constituents, including access to educational engagement that defies time and space. This task is further complicated by an ever-expanding and ever-changing technology market. Trends in higher education have focused on several key areas in technology including security, funding, infrastructure, human capital (IT management, support, training), and academic technology. Each area will be examined as a subtheme.

Network Security

It is not unusual for nursing students to feel comfortable using mobile devices, as many of them grew up using technology. Learning technologies in common use include current evidence-based resources, social media and networking sites such as Facebook and Twitter, and search engines including Google and YouTube.[17] While mobile technology provides an online space for knowledge, it also serves as a gateway for network security issues. Areas of concern for institutional-centered technology users include risk as it relates to FERPA, HIPAA, and intellectual property including funded research.[17] One of the positive aspects of technology is the ability to quickly and efficiently organize vast amounts of personal and valuable data. Exploitation of these data can occur when security measures are not applied. Institutional policies including those focused on technology user awareness are necessary to safeguard private information required for student activities. Clinical agencies may limit student access to patient information and/or prohibit use of mobile devices in response to concern about patient privacy issues.[17,20] Technological advances in providing online learning modalities may unwittingly expose confidential student information in a public forum.[34] Precautions should be considered, and policies should be in place to mitigate potential problems, especially with online collaborative spaces.

Funding

Adoption of technology to transform nursing education and to shift culture toward embracing technology requires buy-in and support by administrative leadership.[18] Information technology expenditure is a balancing act for most institutions of higher education. A primary barrier for institutions to overcome when integrating technology into nursing education is cost.[12,19,20] To address potential accessibility issues due to student and institutional finances, institutions can consider cultivating partnerships with companies seeking to test new educational technology.[11] The company could provide the tools at a reduced cost or no charge to students. For the company, this is an opportunity to test and gain publicity for their products, and the institution receives the benefit of the most updated technology for student learning and success. With a constantly advancing technology market, continual upgrades may be cost prohibitive for institutions of higher learning. For one health professional program alone, costs were determined to be $2.5 million for initial acquisition of specific technology and $174 000 to sustain that one technology. In addition, support staff costs were determined to be $215 000.[16] Learning management systems is expected to be a $15.72 billion business by 2021.[44] Gambo et al[17(p377)] suggested a "bring your own device" strategy, by which students pay for mobile device upgrades through use of scholarship and loan funds. These authors additionally suggested that mandated technology for students' use in programs should be reviewed carefully as this purchase could pose a financial burden to some students. It is not unusual for faculty or students to want the "latest and greatest bells and whistles," and funding is a huge factor in deciding what technology to use.

Infrastructure

Information technology and communication technology provide a means by which time and distance become less of an issue in teaching and learning. To optimize the benefits of technology, the correct technology must be selected for the services planned. In many teaching and learning institutions, nursing programs fall under the umbrella of the larger institution and as such are subject to the IT infrastructure that covers all units. Positive benefits of this model include shared expense and access to data. One negative impact may involve suboptimal fit for the unit. Given the specialized needs of some health sciences programs, infrastructure may need to occur locally within the unit. This local work may create added barriers including additional cost and potential limitations in integration with the institution-level system. Clark et al[18(p92)] argued that technology success is driven by an infrastructure that supports faculty development, which in turn supports faculty who "embrace technology as a tool for student engagement." Identified barriers to successful integration of technology include limitations on high-speed Internet service, lack of IT support, and network interruption.[18]

Human Capital

Clinical agencies expect graduating nurses to be able to interface with technology at hire, including the ability to manage

data in electronic health records, delivery of health education to patients and families, and technology-enhanced direct delivery of patient care.[21] With a demand to produce more qualified professional nurses and the obstacles of limited faculty, budget, and clinical placements, technology may hold the key to workforce development challenges. In using technology, limited resources may be used to advantage to maximize learning opportunities for all students, including those who can benefit from distance technology. For successful integration into practice, students need to begin using technology while in school, and institutional backing is necessary to orient and support students.[18,19] Instructional designers serve as a bridge between faculty creativity and the student experience, and their work is essential in promoting environments that embrace technology. Positives to developing technology-rich learning environments include a collaborative atmosphere in which synergy can evolve. Negatives include time, shared resources, and lack of clarity regarding ownership (eg, who owns the curriculum?).[18] Students are the consumer in the academic setting—consumers of knowledge. They are essentially making a critical decision to invest in their future, their human capital. Alignment with resources to make this investment successful is essential. Students must move from serving as receptacles of knowledge or passive learners, to active, engaged, and committed learners who take charge of their educational experience, and technology provides the freedom for this to occur.[12] In an online learning environment, which is offered to some extent in most nursing programs, prior computer experience is cited as a "prerequisite for success."[24(p345)]

Academic Technology

Sandars[2(p534)] acknowledged that technology use in healthcare education is unlikely to slow down, that there is a shift toward inquiry-based learning that "encourages individual and collaborative inquiry, information seeking and reflection," and that this approach "will sustain practice in the increasingly complex postmodern world." Raman[20] stated that while clinical practice may be a common place to find technology, it can be found in nursing education in the classroom, clinical setting, and skills laboratory/simulation area. Sandars[2] further suggested that mobile devices (smartphones and tablets) are preferred by most students over institutional learning systems and that they will likely eventually take the place of systems such as Blackboard. Ease in portability and ability to access resources including eBooks and course materials make mobile devices desirable. They also allow users to perform administrative tasks including registration for courses, to communicate with peers to share information, and to learn from each other through blogs and other social media. Rubenstein and Schubert[21] recommended that mobile technology be implemented early in nursing student

programs to promote student success through access to learning modalities including several evidence-based resources that support improvement in student confidence and promotion of patient safety.

Classroom and skills laboratory use of technology encourages clinical decision making, critical appraisal, and collaborative learning. Classroom use has been identified with enhanced organization and ability to research and supplement required reading on a variety of topics. Technology has been associated with enhanced clinical skill development and competency. Raman[20] reported that technology use in the skills laboratory supports instant access to resources and feelings of empowerment and facilitates enhanced performance. Many nursing students have essentially grown up with technology and have developed learning styles that thrive in this environment.[17,19] Using this as a foundation, faculty are encouraged to develop teaching-learning experiences that maximize student creativity and learning.[17] Use of technology is a common occurrence in clinical practice, and providing simulation activities that mirror practice in a safe and controlled environment provides opportunity for students to experience "real" situations and use of technology to access resources to provide safe, evidence-based care.[17] Several technologies have emerged in nursing education including augmented reality and virtual simulation.

DISCUSSION

The purpose of this review was to outline the factors for institutions to consider when selecting and incorporating educational technology in nursing programs. It adds to the rapidly growing body of literature, providing institutional stakeholders, faculty, and staff an array of factors worth considering. This review provides the foundation for educators in evaluation and selection of educational technology, tools, modes of delivery, and platforms to integrate with nursing curricula. One consistent theme throughout the literature was that the student learning and professional outcomes should always drive the implementation of technology, rather than forcing programs to fit within the bounds of technology.[2,17,26] Luo and Yang[9(p11)] stated that "Technology should serve as the 'icing on the cake,' to make an already-good learning environment better." Brucker[26(p11)] emphasized that "educators must realize that technology is a method for teaching, not an end unto itself."

To best maximize the educational experience of students and program quality, selection of appropriate technology requires evaluation of the culture of the institution. Additionally important are the skills and attitudes of the faculty and the needs of the students to be successful in undergraduate and/or graduate programs and when transitioning into professional practice. Institutions require the appropriate personnel to orient and assist students with technology[3,8,19–21]

and the necessary financial support to afford implementation.[12,19,20] Hagler et al[37] noted that unless faculty can employ and implement technologies effectively, learners will not understand the full value of those innovative tools. Faculty and clinical sites must, therefore, serve as role models and demonstrate positive attitudes to motivate students to use the selected technology.[19,20]

The literature around mobile technology in nursing education is growing but still limited,[19,45] particularly regarding the rationale for selection of mobile platforms.[12] However, mobile technology seems to hold the most promise for the diverse students enrolled in nursing programs, flexibility in options to match students' learning styles and proficiencies, and the learning and professional outcomes necessary for nursing students to be successful in the workplace.[18,21] A few considerations were deemed noteworthy in this review. Kenny et al[46] emphasized not only the importance of orienting students and faculty to mobile technology, but also the provision of time for students to learn how to adequately use the technology. The authors noted that students reported mobile devices to be effective, but busy courses kept them from fully learning all the available features. These authors also noted some potential barriers to incorporating mobile technology in nursing education, such as cost, policies, accessibility to wireless connections, and who provides the financial support for those wireless connections, whether it be students, institutions, or clinical agencies.[46]

An additional theme that arose from the review was the need for clinical sites to also support the integration of technology into nursing education.[19,20] This extends beyond the control of higher education institutions, faculty, or students, and it is essential that nursing programs seek clinical partnerships that will support the learning and professional outcomes necessary for nursing graduates to be successful. Future studies should document how institutions and clinical agencies facilitated the integration and support of educational technologies across sites to maximize students' learning experiences.

Finally, nursing will continue to see the integration of technology with practice. The demand for access to patient care through telehealth and mobile health will also continue to rise.[10,12] Therefore, nursing education must equip students with the skill set needed to succeed in the technology-based workplace. A direction worth consideration is providing students the opportunity to complete a minor, professional certificate or curricular strand in nursing informatics and technology.[11]

CONCLUSION

As nursing learns from other disciplines, especially from the education pedagogical models that have evolved over the decades, nursing content delivery methods for didactic nursing courses have changed the emphasis on how the student-faculty roles are perceived and how content learning is evaluated, demonstrated, and synthesized in the clinical settings. In addition, there is a strong appreciation for nurse educators to be grounded in the concepts of learning styles and critical thinking.[47] Nursing education is recognizing the value of active learning in the adult education arena. Nurse educators are challenged to provide relevant content in the classroom that is transferable to clinical settings, to develop meaningful teaching styles (active/interactive) to encourage students to link theory to practice, and to motivate and challenge students in ways that captivate and activate critical thinking.[46,48] McCabe and Timmins[39] argue that current learning strategies focus on clinical practice technologies involved in the three main learning environments of lectures: classroom—live or virtual, simulation-engaged, active learning, and clinical practice-engaged application of knowledge; critical thinking; and experience building of skill sets.

Consumers of healthcare (patients) demand quality care and expect highly skilled, compassionate, ethical practitioners. At the fundamental core of quality care are the training and education of future nurses by skilled, qualified nurse educators who are comfortable with technological demands of all aspects of healthcare. Nurse educators must adapt when technology fails or when situations occur that interrupt the "normal" didactic delivery method (severe weather or other events).[49] Continued evaluation of technology in the classroom and clinical settings through good-quality studies with sufficient rigor are essential to support the transfer of knowledge from the classroom to patient care settings. Research into how nursing education is designed, delivered, and evaluated is complicated by faculty expertise and training, the focus of the research (learning theory models, student learning styles, program, and course delivery methods), available technology, and both faculty and student experiences with the available technology. Nursing programs are evaluated and judged on first-time NCLEX pass rates for purposes of accreditation. Students and stakeholders may have other criteria by which a nursing program is considered successful. Nurse educators need to continue to challenge, question and evaluate not only the technology that is being used in our programs, but also the cost-benefit of that technology to the faculty, the student, the institution, and the community of practice.[9] Rather than just accept new technology, nurse educators should be asking for the evidence that the technology benefits the student, improves learning, and offers stakeholders assurance that new nurses are hired with the best academic training possible for their chosen clinical settings.

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