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Welcome to *Journal of Applied Instructional Design*’s special issue on medical and healthcare education. My name is Dr. Atsusi “2c” Hirumi, and I had the honor of working with Dr. Don Robison, the Director of Community-Engaged Learning at Eastern Virginia Medical School, Julie Bridges, the Senior Editor of JAID, and all of the contributing authors to put this special issue together. I also have the distinct pleasure of introducing and providing you with an overview of the issue.

Since Robert Gagné’s inception of system design and Richard Glaser’s development of instructional systems for the military in the early 1950s and 1960s, instructional designers have teamed up with subject matter experts and media specialists, and have applied systematic design tools to enhance teaching and learning across different sectors, including K12 and higher education, aviation, hospitality, and healthcare, among others. In medicine, Riesenber, Little, and Wright (2009) found that professionals with either a master’s or doctorate degree in education or a related field, or a clinical educational background with added training or experience in education have been helping prepare physicians for over 80 years. With today’s increasing demands on medical and healthcare practitioners, the popularity of such education specialists continues to grow.

In general, medical and healthcare practitioners tasked with defining curriculum and creating educational programs to prepare the next generation of professionals, receive little training in teaching, learning, and instructional design. Practitioners must now also deal with increasing documentation requirements, varying data systems and health plans, rising patient expectations, loss of autonomy, and demands to decrease costs and increase revenue, along with the continued exponential growth of information and treatment options. Given such complexity, instructional designers, educational psychologists, educational technologists, and others (hereby referred to as education specialists), with a solid understanding of learning research and theory, needs assessment, task analysis, objectives, learner assessments, curriculum development, etc. can play a vital role in designing effective, efficient, and engaging learning experiences.

For education specialists new to the field, the challenges of establishing rapport with medical and healthcare professionals, along with acquiring subject matter expertise, and a critical understanding of the contemporary issues facing a wide range of professionals in various schools, hospitals, clinics, and other health-related facilities, may seem overwhelming. To gain credibility, education specialists must also grasp medical and healthcare terminology as well as learn the methods used to facilitate medical and healthcare education, and they must do so rapidly as they demonstrate their own expertise and the relevance of grounded design and systematic processes.

The fundamental purpose of the special issue of the JAID is to nurture collaboration between academics and practitioners in instructional design and healthcare as a means of advancing learning and disseminating new ideas. To achieve our purpose, I worked with the editors of JAID to solicit and select a set of articles that will help you gain knowledge of how systematic design tools, techniques, and practices are being applied to facilitate medical and healthcare education, and identify factors to consider when collaborating with medical and healthcare faculty, staff, students and administrators. We have also
featured articles on the design and development of educational programs that are relatively unique to medical and healthcare education to give you a taste for some of the engaging, effective, and efficient learning experiences that are being created to prepare the next generation of medical and healthcare professionals.

The special issue begins with two articles that discuss the skills, knowledge, and dispositions education specialists must have to facilitate medical and healthcare education. Specifically, in the first article, I worked with faculty, staff, and students at the College of Medicine at my home institution to characterize the design and development of medical school curriculum, learning goals and objectives, learner assessments, instructional strategies, and learning resources. We also identified key factors to consider when collaborating with MedED faculty, students and administrators from each stakeholder’s perspective. The second article by Kurzeil and Marcellas provide further insights on the collaborative design process by expounding on the composition and expertise of instructional design and development team members, and exploring the need for teams of learning engineers to leverage big data, and the use of data analytics to advance medical and healthcare education.

The second set of articles describe the application of systematic tools and techniques to facilitate the design of two prevalent instructional methods specific to medical and healthcare education: that is, virtual patient (VP) simulations and interprofessional education (IPE). In the third article, King and a team of physicians and nurses illustrate how storytelling and the science of instructional design were used to create branching VP simulations that align learning objectives with decision points, consequences, coaching, and performance metrics. Breitenbach and Gronseth then posit their Content-Evaluation-Method (CEM) instructional model for guiding the design of IPE curriculum that aligns key components of IPE content, evaluations, and pedagogical methods. The last two articles delineate current methods being widely considered in medical and healthcare education to enhance degree programs and professional development. Specifically, Wantuch and her colleagues delineate the systematic processes used to design an education concentration that was established to enhance a doctorate in Pharmacy. In the last article, Burton-MacLeod and Carliner describe the systematic process they used to create microlearning modules to support transfer and the professional development of nurses.

Taken together, the articles included in the special issue only begin to touch on the collection of systematic design tools and techniques, and the array of innovative programs that are now advancing medical and healthcare education across the nation. But it is expected that the compilation of articles will help instructional designers and other educational specialists build a solid knowledge base to promote medical or healthcare education. As the articles suggest, the complexities and challenges associated with facilitating medical or healthcare education are many, but so are the opportunities. I hope you will enjoy reading the articles and will find one or more particularly useful for facilitating your professional endeavors that will ultimately nurture fruitful collaboration between academics and practitioners to disseminate new ideas and advance learning in medical and healthcare education.
What do instructional designers and educational psychologists need to know to work effectively in medical education

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Abstract: Instructional designers, educational psychologists, and other education specialists have much to offer faculty, staff, students, and administrators in medical schools, but also face significant challenges as they seek to collaborate with the key stakeholders to enhance student engagement and learning. To gain acceptance and realize opportunities to enhance student engagement and performance, it is essential for specialists who come from outside medical education (MedED) to build the trust and aptitude necessary to affect change. Not only do they have to demonstrate competence within their own areas of expertise, they must also quickly gain knowledge of the subject matter, as well as key trends and issues facing various stakeholders. They must also exhibit exceptional interpersonal communication skills, apply change management concepts, and have a clear understanding of their role and where their expertise fits in the larger picture of a course, curriculum, or organization.

We recognize that many basic skills are necessary to be effective team members across industries, and thus do not detail them here. Considerable resources are available on the development of interpersonal communication and change management skills for instance. Rather, the purpose of this paper is to characterize issues that are particularly relevant for education specialists who are either currently working or seeking opportunities in MedED. Specially, we identify and discuss (a) common instructional methods and means, and (b) factors to consider when collaborating with MedED faculty, staff, students and administrators. As a feature of the discussion on collaboration, we will turn to representatives from each stakeholder group to forward their priorities and challenges, along with their impressions of education specialists. With input from the various stakeholders, we hope to provide a view of the challenging field that both informs and inspires education specialists either currently or interested in working in MedED.

Keywords: Medical Education, Instructional Design, Instructional Designers, Educational Psychologists, Educational Specialists, Non-Physician Medical Educators

Many challenges face instructional designers, educational psychologists, and other education specialists who work to facilitate teaching and learning in medical schools. Not only do they need a strong reputation to build trust and acceptance from medical school faculty, staff, students and administrators, they must also rapidly gain knowledge of complex subject matter, address conflicting cultures, exhibit exceptional interpersonal communication skills, and apply change management concepts in a deft and nimble manner.

Collaboration between physicians and education specialists traces back to the 1920’s (Haggerty, 1929; Hirschfelder, 1929) with the first sustained partnership between physicians and educators to improve medical education (MedED) seen in the 1950’s at the University of Buffalo. Since then, as our understanding of teaching, learning, and instructional design continues to advance, and medicine and Med-ED becomes increasingly complex, more medical educators are embracing the science of education and the need for education specialists to fill roles that do not require a physician’s expertise. In a review of the literature on health care professionals working as non-physician medical educators, Riesenberg, Lit-
tle, and Wright (2009) found an increase in the number of articles published per decade, with one publication in the 1960s, seven in the 1970s, seven in the 1980s, twelve in the 1990s, and twelve published between 2000 to 2007. It is safe to assume that the number will continue to increase.

The purpose of this paper is to characterize particularly relevant practices and issues for education specialists to consider if they are either new or seeking opportunities to facilitate MedED. First, we describe common instructional methods and means, and then discuss factors to consider when collaborating with MedED faculty, staff, students and administrators. We conclude by noting emerging trends and issues that we believe may affect MedED in the near and not too distant future.

Common Instructional Methods and Means

Our description of common methods and means centers on five basic instructional elements that fall within the purview of instructional designers, educational psychologists, and others (hereby referred to as education specialists), including the analysis, design, and development of (a) the curriculum, (b) learning goals and objectives, (c) learner assessments, (d) instructional strategies and activities, and (e) learning resources and technologies.

Curriculum

Medical schools, also referred to as Undergraduate MedED programs, conferring M.D. degrees in the United States and Canada are required to be accredited by the Liaison Committee on Medical Education (LCME) (lcme.org). The LCME outlines the structure and functions of a medical school. There are 12 comprehensive standards covering everything from the mission, leadership and faculty of the medical school, the curricular content, design and management, to the academic and medical/health support for students (AAMC & AMA, 2019). To be accredited or to maintain accreditation, all medical schools operated by universities or chartered in the US and Canada must comply with these standards. While all accredited medical schools are based on these foundational standards, there is variance in how medical schools interpret the standards and thus, design policy and programs to comply with the standards. The latter represents the unique features of each medical school and defines their mission, culture, climate and curriculum.

The LCME standards require that the medical school faculty state learning objectives using outcome-based terminology that can be assessed (AAMC & AMA, 2019). The LCME also specifies that the learning objectives must support the mastery of skills and knowledge in foundational biomedical, behavioral and socioeconomic science; human anatomy and physiology; clinical reasoning, and other broad areas detailed further under the next section on Learning Goals and Objectives. In addition, the LCME requires that students have a sufficient amount of both inpatient and outpatient clinical exposure to function independently in a residency program upon graduation.

According to LCME, MedED must include at least 130 weeks of instruction. Most US medical schools spread these weeks across 4 years, with 2 years of preclinical training and 2 years of training in clinical clerkships. In the preclinical years, the primary focus is on knowledge acquisition, the application of the foundational sciences and the development of the clinical skills and dispositions needed to effectively function as a physician-in-training. The clinical years are dedicated to completing core clerkships and electives, which vary by school. Clerkship sites vary by institution as well. Students in large, well-established medical schools with teaching hospitals, access to both numerous clinical sites, and/or sufficient resources to pay faculty to teach at local clinical settings, can often complete their clerkships locally. Students attending medical school in remote areas or at schools with fewer resources may temporarily relocate to another city to complete required clerkships. As students begin to consider residency applications, they may also elect to travel to other locations to complete clerkships that align with their specialties or locations of interest.

To comply with LCME standards, medical schools must have a group that provides oversight for the MedED program and there must be sufficient opportunities for students to provide feedback about the MedED program (AAMC & AMA, 2019). The standards also require that medical schools use national norms as demonstrations of students’ achievement of medical school objectives. Accomplishments commonly reported are board examination scores and National Resident
The process of matching students to residencies in specific areas of practice is managed by the National Resident Matching Program (NRMP). Typically, in the 3rd and 4th year, students complete elective clerkships in specialties and at clinical sites where they hope to match. In the 4th year, residency program directors submit a rank ordered list of preferences for students who interviewed for a residency spot in their program. Similarly, students submit a rank ordered list of preferences for the programs where they interviewed. On Match Day, in March, students across the nation find out if and where they matched. The NRMP (2014) have cited performance on the high-stakes United States Medical Licensing Exam (USMLE) Step 1 and Step 2 exams as the first and fourth most considered factors when matching medical students. The USMLE Step 1 assesses basic science knowledge, USMLE Step 2 CK assesses clinical knowledge, and USMLE Step 2 CS assesses Clinical Skills. Schools require students to complete Step 1 at various times during their program of study (AAMC, 2018). A passing score on Step 1 is required to submit an application for postgraduate clinical training (residency) and can influence student’s prospects of matching to a residency (Mowery, 2015).

Learning Goals and Objectives

The LCME requires medical school faculty to define measurable learning objectives that support sufficient mastery of:

- Foundational biomedical, behavioral and socioeconomic science needed to master medical science knowledge and apply it to both patient and population health.
- Human anatomy and physiology across organ systems and the life cycle.
- Prevention, differential diagnosis and treatment planning.
- Knowledge and skills needed to provide care to a multidimensional and diverse population.
- Clinical reasoning skills adequate to function in residency.
- Scientific method and the ability to read, understand and critically appraise biomedical, translational and clinical research.
- Ethical issues and the ability to apply principles of medical ethics.
- Team functioning - how to function as a member of an interdisciplinary health care team.
- Personal attributes that influence patient care, including cultural competence, cultural humility, and communication skills.

Medical educators may also utilize a priori objectives specified by: (a) experts within a field of study, such as 60 physiology objectives defined by a committee of physiology department chairs (Carroll, Navar, & Blaustein, 2012); or (b) existing educational curricular frameworks and materials to define learning goals and objectives. In other cases, medical educators may work with instructional designers to complete a series of cognitive task analyses to identify essential knowledge and skills which, in turn, serve as the basis for crafting the educational goals and objectives (e.g., Clark et al., 2012; Yeung et al. 2017). Regardless of how learning goals and objectives are derived, the primary purposes for defining measurable outcome statements should remain the same – to communicate expectations, focus learners’ and educators’ attention, delimit (need vs. nice to know) content, and define and align learner assessments (Dick, Carey, and Carey, 2015; Hirumi, 2014). The challenge lies in working with MedED faculty and staff to achieve such purposes.

Learner Assessment

Medical schools are challenged with assessing students’ knowledge of basic science as well as their clinical skills and professional dispositions. When utilized with strategic purpose, assessment has a “positive steering effect on student learning and the curricu-
lum” (Amin, Seng & Eng, 2006, p.3) and serves multiple functions in the school. In program evaluations, assessments reflect the level of achievement related to learning objectives or competencies and serve as indicators of effective teaching. In student evaluation, assessments provide formative feedback, determine or certify competence, predict future performance and/or determine readiness to advance in training (Amin, Seng & Eng, 2007; Epstein, 2007). Perhaps most important, assessment in medical education protects the public interest by identifying students who lack the requisite knowledge or skills to effectively and ethically function as physicians (Epstein, 2007).

Miller’s Framework for Clinical Assessment (Miller, 1990), more commonly referred to as Miller’s Pyramid (depicted in Figure 1) is a popular assessment model in medical education. While there are efforts to update and amend Miller’s framework (e.g., Al-Eraky & Marei, 2016; Cruess, Cruess & Steinert, 2016; von Hyenheim, 2017), four levels of the pyramid remain prevalent for distinguishing medical school assessments and outcomes.

Miller’s pyramid begins with Knows (knowledge) at the base of the pyramid. Level one represents what students need to know in order to function effectively as a physician. Miller proposed that Knows How (competence) represent the second level of the pyramid. At this level, students demonstrate their competence at gathering and synthesizing data from a variety of sources in order to diagnose conditions and define management plans. Multiple choice tests are popular form of assessment for the Knows and Knows How levels, though long or short essay items and oral exams are also used (Amin, Seng & Eng, 2006; Kibble, 2017).

Level three of Miller’s pyramid, Shows How (performance) represents a student’s ability to demonstrate, through performance, their competence at using and synthesizing data, determining a differential diagnosis and a management plan in clinical applications (Cruess, Cruess & Steinert, 2016; Miller, 1990). Applications at this level are typically in simulated clinical scenarios or under supervision in authentic clinical settings (Miller, 1990). Assessment of abilities at this level include the Objective Structured Clinical Examination (OSCE) and the Long and Short Case (Amin, Seng & Eng, 2006).

Interest at the top of Miller’s pyramid, Does (Action), focuses on the level at which a student can function independently (Cruess, Cruess & Steinert, 2016), on what a student does in an authentic clinical practice (Miller, 1990). A variety of assessment types are utilized at the Does level, including direct observation, checklists, self-assessment, peer-

assessment, log books, portfolios, Mini Clinical Evaluation Exams (Mini-CEX), Direct Observation of Procedural Skills (DOPS), Clinical Work Samplings (CWS), and 360-Degree Evaluations (Amin, Seng & Eng, 2006; Kibble, 2017).

There is no doubt that assessment drives learning in MedED (Muijtjens, Hoogenboom, Verwijnen & Van Der Vleuten, 1998; Wormald, Schoeman, Somasunderam, & Penn, 2009) and becoming a licensed physician in the United States requires a willingness to succumb to frequent assessments, some of which carry extremely high stakes. Medical schools utilize both formative and summative assessments to determine student’s mastery of knowledge or skills at both the preclinical and clinical levels (Amin, Seng & Eng, 2006). But beyond assessments in the local medical school, students must complete the USMLE Steps 1, as well as the USMLE Step 2 and Step 2 CS in order to apply for residency positions. The weight the USMLE carries in determining a successful match for students has created what was recently labeled, the “Step 1 Climate.” An unintended consequence of this climate, paired with the increasing number of for profit USMLE preparation resources (Chen, Priest, Batten, Fragoso, Reinfeld, & Laitman, 2019), is students’ disengagement from the formal medical school curriculum. However, despite the importance of the USMLE scores to students’ successful residency match, the evaluation of the student, as assessed through the medical school grading system, also contributes to the successful match.

Grading systems in medical schools are locally determined, leading to a lack of consistent grading schemes across medical schools in the United States. A majority of medical schools utilize some version of a pass/fail system, others utilize an honors, pass/fail system, while others still maintain the traditional letter grade system or assign a numerical grade (AAMC, 2019). Since assessment types and grading systems vary across medical schools, student’s performance on the rigorous standardized USMLE represents one of the few objective and valid measures for residency directors to compare students’ knowledge and skills across medical schools (Gauer & Jackson, 2017).

For instructional designers and education specialists, the reported associations between USMLE Step scores and residency specialty matches (Gauer & Jackson, 2017) can’t be ignored. From a curricular perspective, the current power of the STEP scores inflates the importance of medical knowledge and undermines other critical aspects of medical training as identified by the Accreditation Council for Graduate Medical Education (www.acgme.org), such as patient care, practice-based learning and improvement, professionalism, interpersonal skills and communication, and systems-based practice. For faculty, they must consistently balance the tension between meeting ALL the learning objectives of the training program and students’ preferences for (and trust in) commercially available step preparation materials, their tendency to interpret the non-medical knowledge aspects of their training as ‘low yield’ (Chen, Priest, Batten, Fragoso, Reinfeld, & Laitman, 2019), and the medical profession’s current over reliance on an assessment score that was not originally designed for selection purposes (Gauer & Jackson, 2017). For students, varying levels of physical and/or psychological distress are expected as they approach and complete evaluative assessments, but the increased rates of psychological distress among medical students are attributed, in part, to the current “Step 1 climate” (Chen, Priest, Batten, Fragoso, Reinfeld, & Laitman, 2019). Medical school faculty, instructional designers and education specialist must be aware of how this environment influences student motivation, values, engagement, physical and psychological health, and relationships and family. Optimally, the goal is to design curriculum and instruction that aligns with students’ need to efficiently store, retain and recall massive amounts of medical knowledge, without sacrificing neither the presence or the value of learning encounters that build competency in the areas the student will need to function with reasonable autonomy upon entering residency.

Learning Strategies and Tactics

A variety of strategies and tactics are used to facilitate learning in medical schools, including but not necessarily limited to readings, lectures, online (self-learning) modules, discussions, problem-based learned, case-based learning, team-based learning, and peer-teaching (c.f., Swanwick, 2014; Thomas, Kern, Hughes, & Chen, 2016). We distinguish learning strategies and tactics to advance our discussion on grounding the design of learning
experiences in research and theory (Zintgraff & Hirumi, in press).

Learning strategies are comprised of a cohesive set of instructional events that are designed and sequenced to facilitate the achievement of a specified group of outcomes associated with an entire instructional lesson, unit, or module. For example, Table 1 lists the instructional events associated with problem-based learning; one of the most prevalent strategies, posited by Barrows (1985), that has been applied in medical education and across disciplines for over 40 years (Neville, 2005; Xian & Madhavan, 2013).

Table 1. Prescribed series of instructional events for facilitating problem-based learning.

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<td>1. Start New Class</td>
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<td>1.1 Introductions</td>
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<td>1.2 Climate Setting (including teacher/tutor role)</td>
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<td>2. Start New Problem</td>
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<tr>
<td>2.1 Set and bring problem home</td>
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<td>2.2 Describe the product/performance required</td>
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<td>2.3 Assign tasks</td>
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<td>2.4 Reason through the problem (i.e., ideas/hypotheses, facts, learning issues and action plan).</td>
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<td>2.5 Commitment as to probable outcome</td>
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<td>2.6 Learning issues shaping/assignment</td>
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<td>2.7 Resource identification</td>
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<td>2.8 Schedule follow-up</td>
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<td>3. Problem Follow-Up</td>
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<tr>
<td>3.1 Resources used and their critique</td>
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<tr>
<td>3.2 Reassess the problem (i.e., ideas/hypotheses, facts, learning issues and action plan).</td>
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<td>4. Performance Presentation(s)</td>
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<td>5. After Conclusion of Problem</td>
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<tr>
<td>5.1 Knowledge abstraction and summary</td>
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<td>5.2 Self-evaluation</td>
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Other common learning strategies prescribed to facilitate MedED include team-based learning (e.g., Fatmi, Harting, Hillier, Campbell, & Oswald, 2013; Parmelee, Michaelsen, Cook & Hudes, 2012; Parmelee, Sweet & Sweet, 2008) and case-based learning strategies (Thistlethwaite et al., 2012).

In comparison, learning tactics are more discrete than strategies and are defined as specific tools, techniques, or activities that are prescribed to facilitate the application of a learning strategies or in combination with other tactics to facilitate learning (c.f., Zintgraff & Hirumi, in press). Common tactics used to facilitate MedED include lectures, textbook readings, question-banks, discussions, and self-learning modules. When combined and sequenced in an intentional fashion (e.g., based on learning theory), a cogent set or sequence of instructional events and tactics form a learning strategy.

Similar to what we see posited in the instructional design literature (e.g., Hannafin, Hannafin, Land, & Oliver, 1997), MedED textbooks also note the importance of grounding educational practices in research and theory, and discuss the application of adult, social cognitive, self-directed, experiential, and situated learning theory, among others (e.g., Swanwick, 2014). Persuasive and well-supported calls for evidenced-based medicine (Sackett, 1996) also help medical educators relate to the notion of evidenced-based MedED and grounded design (e.g., Groccia & Buskist, 2011; Petersen, 1999; Wolf, Shea, & Albanese, 2001). However, the degree to which medical educators apply theoretical or evidence-based practices may vary, paralleling their knowledge and acceptance of learning theories and educational research. One important function education specialists may serve in medical schools is to increase knowledge of alternative learning theories, strategies, and tactics to ground the design of learning experiences and to promote evidence-based MedED.

Fueled by research suggesting that active sense-making and knowledge construction result in long-term retention, deeper understanding, and transfer (c.f., Prince, 2004; Fink, 2003; Bonwell & Eison, 1991), active learning strategies have been applied to facilitate MedED for over the past century (Graffan, 2007; Thistlethwaite et al., 2012). With roots going back to the case method used to teach pathology in 1912 (Sturdy, 2007, cited by Thistlethwaite et al., 2012), active learning was popularized, more recently, by both problem-based learning (Barrows & Tamblyn, 1980; Barrows, 1985) and case-based learning strategies (Thistlethwaite et al., 2012). Active learning continues as a key attribute of team-based learning (Hunt et al., 2003), and most recently, the flipped classroom (Ramnanan & Pound, 2017).

However, in contrast to research and the
development of active learning strategies, educators still lament the lack of pedagogical change in MedED (DaRosa et al., 2011; Mickelson, Kaplan, & Macneily, 2009; Straus, Glasziou, Richardson, & Haynes, 2019). With little time, training, or incentives, medical educators revert to what they know best; that is, teacher-directed educational methods and materials (Hirumi, 2002; Hurst, 2004). While our knowledge of medicine has advanced tremendously over the past decades; our methods for teaching medicine have not. To enhance medical education, education specialist must be well grounded in their knowledge of active learning theory, possess the ability to design student-centered learning environments, and be prepared to serve the role of change agent.

**Learning resources and technologies**

A variety of resources are both prescribed by medical schools and acquired by medical students on their own volition to facilitate learning and performance both in and -of-class, and to prepare for national board exams. Table 2 lists resources prescribed by schools that are either supported by the Educational Technology Department or the Library, depending on how budgets and personnel re-

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Table 2. Sample resources prescribed by medical school

<table>
<thead>
<tr>
<th>Resource</th>
<th>Short Description &amp; Uses</th>
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<tbody>
<tr>
<td>Webcourses</td>
<td>Online portal and application for classwork, assignments, calendar and course content.</td>
</tr>
<tr>
<td>Kuracloud</td>
<td>Software for small group cases and activities are hosted and completed.</td>
</tr>
<tr>
<td>Examplify</td>
<td>Software for secure test-taking on laptop.</td>
</tr>
<tr>
<td>CoursEval</td>
<td>Survey website to rate our classes and professors.</td>
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<tr>
<td>Complete Anatomy</td>
<td>Cloud-based education application platform allows users to investigate the minute detail of the human anatomy in incredible 3D.</td>
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<tr>
<td>Examsoft</td>
<td>Website to submit assignments for grading and feedback.</td>
</tr>
<tr>
<td>Panopto</td>
<td>Software for recording lectures and hosting them online.</td>
</tr>
<tr>
<td>Endnote</td>
<td>Software for managing references.</td>
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<tr>
<td>UpToDate</td>
<td>Online app provides evidence-based clinical decision support resource authored by physicians to help healthcare practitioners make the best decisions at the point of care.</td>
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<tr>
<td>Visual Dx</td>
<td>Online app provides clinical decision support system that helps clinicians recognize and visually diagnose presenting conditions.</td>
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<tr>
<td>DynaMedPlus</td>
<td>Online app provides clinical reference tool for physicians with content written by a team of physicians and researchers who synthesize the evidence and provide objective analysis.</td>
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<tr>
<td>Access Medicine</td>
<td>Online app by McGraw-Hill Medical provides instant answers to clinical questions from trusted resources such as Quick Medical Dx &amp; Rx and Fitzpatrick’s Color Atlas of Clinical Dermatology. Also includes Diagnosaurus – a differential diagnosis tool, and Diagnostic Tests – a quick reference of commonly used tests.</td>
</tr>
<tr>
<td>Clinical Key</td>
<td>Online app provides physicians with clinical resources and fast, clinically-relevant answers from Elsevier’s enormous library of proprietary medical and surgical content.</td>
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<tr>
<td>MedOne</td>
<td>Online app provides access to the library’s Thieme e-books, e-journals, and video subscriptions, including MedED and radiology content.</td>
</tr>
<tr>
<td>Pediatric Care Online</td>
<td>Premier online app provides point-of-care resource that integrates different pediatric resources for quick access when needed, such as Red Book, Well Child resources, the Bright Futures books, and the AAP textbook.</td>
</tr>
<tr>
<td>Epocrates</td>
<td>Online app provides drug information, interaction check, pill ID, clinical practice guidelines, formulary, athenaText, tables, and calculators.</td>
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sources are distributed throughout the school to acquire, deploy, maintain and update the use of learning resources and technologies.

Table 2 is not an exhaustive list of learning resources used in MedED. Rather, the list is a sampling of tools and technologies that represent the breath and nature of resources used to facilitate MedED. Other significant learning tools and technologies used in medical schools include, but are not limited to low to high fidelity simulations, artificial and virtual reality, social media, and laboratory and classroom presentation equipment (Moran, Briscoe, & Peglow, 2018).

Table 3 lists a sample of learning tools, which we refer to as MedED-COTS (commercial-off-the-shelf) resources, which medical students often acquire on their own volition to prepare for national board exams. The MedED-COTS offer different functions and features, such as, but not limited to USMLE style question banks, text, videos, flashcards, and data analytics to help students prepare for that national Step 1, 2 and 3 board exams. Students pervasive use of such resources (also referred to as the informal or hidden curriculum), however, has led to a number of concerns.

To prepare for high-stakes certification exams, it could be expected that students would rely on curricular material and experiences provided by their institution. However, within the last decade, research suggests that, when it comes to preparing for Step 1 and 2 board exams, students may spend more time and effort using MedED-COTS developed by third-party companies than their medical school lecture materials (Burk-Rafel, Santen, & Purkiss, 2017). It appears that, at least for some students, MedED-COTS offer an effective and efficient means of acquiring the basic scientific knowledge and analytical skills necessary to achieve high scores on the national (Step 1, 2 and 3) board examinations.

When considering the use of learning resources, education specialist should note that students and faculty may have conflicting views on the purpose of undergraduate medical school and the value of MedED-COTS. Informal interactions with students highlight concerns that their medical school curriculum is not adequately preparing them for Step. Subsequently, they are purchasing subscriptions to MedED-COTS to optimize their chances of passing and achieving high scores on the exams. They also express concern for instructional content and activities that are not directly related to Step. Faculty, in contrast, are concerned that MedED-COTS may contain errors or omissions, and that students are viewing these resources as a high yield, primary source of knowledge over the coursework and materials that are generated and prescribed by faculty. To collaborate effectively with MedED faculty, staff, students and administrators, education specialist must become knowledgeable of both formal and

<table>
<thead>
<tr>
<th>Resource</th>
<th>Short Description &amp; Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anki</td>
<td>Online app for flashcards from various sources including lecture-based decks, and decks curated from specific resources &amp; textbooks.</td>
</tr>
<tr>
<td>Pathoma</td>
<td>Review videos in PowerPoint style and accompanying review book with outline of videos and some pictures.</td>
</tr>
<tr>
<td>Goljan Lectures</td>
<td>Audio recordings of a med school professor teaching pathology with accompanying slides and a link to a Utah medical school website that has interactive arrows.</td>
</tr>
<tr>
<td>Boards &amp; Beyond</td>
<td>Video lecture series by Dr. Ryan with accompanying review book, loosely follows format of First Aid.</td>
</tr>
<tr>
<td>Sketchy Medical</td>
<td>Animated (visual) mnemonics with associated audio narration of various pathology, microbes, and drugs.</td>
</tr>
<tr>
<td>Picmonic</td>
<td>Animated (visual) mnemonics with associated audio narration-longer than Sketchy and mostly focused on pathology.</td>
</tr>
</tbody>
</table>
informal curriculum resources and gain an understanding of each stakeholders’ potentially varying values and beliefs.

**Key Factors to Consider When Collaborating with Stakeholders**

Like work in other industries, collaboration is essential. To enhance learning and facilitate change, education specialists must collaborate effectively with medical school faculty, staff, students and administrators. Although Riesenberg, Little, and Wright’s (2009) review of literature suggests that education specialists are gaining acceptance among medical educators, such alliances can be difficult considering the differences in professional backgrounds, priorities, and challenges found across stakeholders. To be successful, education specialist must understand the roles and responsibilities of each stakeholder group, as well as learn to balance and address each group’s varying skills, knowledge, and dispositions toward teaching, learning, and instructional design.

**Collaborating with Faculty**

Faculty in medical schools include clinicians and non-clinicians. Clinical faculty are physicians with varying levels of teaching in their job time/effort assignments. Non-clinical faculty include foundational science educators, education specialist, educational technologist, and non-physician educators with advanced degrees and/or experience in clinical education, such as nurses or physician assistants (Riesenberg, Little, & Wright, 2009). Weinberger (2009) further differentiates between the clinician teacher and the clinician educator, noting the time and effort for the clinician teacher is primarily clinical, with a small amount of time or effort dedicated to teaching and research. Clinician educators also have clinical duties, but their time and effort is more balanced between clinical and educational responsibilities, with the latter representing the primary path to academic advancement. Medical school faculty often transition to leadership roles as their careers advance. They may direct courses, programs, clerkships or attain positions as deans of departments or divisions. (Weinberger, 2009).

Successfully implementing the curriculum of even a well-established medical school requires the strategic utilization of faculty types, time and effort assignments and career development initiatives. Variances in types of faculty, time and effort assignments, formal training and experience in education, and clinical vs. non-clinical training and experience impact the design and implementation of the educational program. For instance, regardless of clinical faculty time and effort assignments, commitment to patient care and clinical duties often take precedence over teaching. Clinician educators are often spread thin, either by choice (over-commitment) or the educational demands of the curriculum. Foundational science educators can also juggle multiple priorities, especially if their time and effort assignment includes both teaching and competitive research responsibilities. If the pathway to advancement is primarily research, non-clinician educators must balance priorities between educational responsibilities and those that are most likely to result in promotion. The time and effort assignments for other non-physician faculty, such as education specialist and technologist, are typically related to teaching and/or educational research but, given their lack of clinical training or expertise, they are often dependent on the foundational scientist and clinical faculty to successfully complete their assigned duties. Awareness of these complexities are even more important when there is interest in or mandates for changes in the curriculum or curricular reform.

The path to becoming a physician is competitive and demanding. Physicians have invested a great deal of time, effort and cost to become doctors so, for some, navigating medical school represents a ‘rite of passage’ to the profession. Clinical educators have demonstrated mastery at navigating very demanding and complex educational programs and assessments, designed to shape and measure professional knowledge, skills, attitudes and identity. While non-clinician educators also invested a great deal of effort, time and cost to attain their credentials, they have not had the same undergraduate and graduate medical experiences as physicians who successfully navigated their rigorous program and thus, may expect others to navigate it as well (Petersen, 1999). Similarly, foundational science faculty have successfully navigated the educational and other professional requirements of their respective disciplines. In both cases, their previous success as students and current expertise as professionals in their respective fields can sometimes be confused with expertise in edu-
cation. However, unless faculty also obtained additional degrees or certifications in education (and many have), they are not experts in education, and may lack the requisite knowledge or experience in learning theories, curriculum development, instructional design, evaluation and assessment (Riesenberg, Little, & Wright, 2009). Beyond that, foundational science faculty have not experienced MedED and thus, tend to target teaching goals aligned with expertise in their discipline, rather than identifying the clinically relevant, discipline specific, concepts and principles that future physicians will need to address the variety of patient presentations. (Weston 2018). Similarly, the basic science principles that physicians learned as medical students have been subsumed, as a result of their clinical training and experience, into “illness scripts” (Schmidt, Norman & Boshuizen, 1990). Clinical skills and reasoning have become automated for clinical faculty so it is often difficult for clinicians to convey the foundational concepts, principles and skills at an introductory level that is understandable to novice learners. Despite calls to utilize evidence-based teaching in MedED, curricular decisions are often opinion based (Harden, 1999), dependent on the educational experiences of the faculty, without consideration for how students, education, access to knowledge, and even health care has changed since their matriculation (Peterson, 1999).

No professional can fully relate to the training of another professional unless they experienced the same training path. This is an important consideration for education specialist and/or educational technologist working collaboratively in a MedED setting. While education specialist may have expertise and extensive experience in learning theory, instructional design, assessment, pedagogy, student motivation and engagement, they have not had to navigate undergraduate or graduate MedED, nor gone through the demands of licensing. Physicians, on the other hand, are immersed in education for decades. They were likely top students in their secondary and post-secondary education, were able to secure a competitive residency and gained enough clinical experience to serve as a medical educator. This can be an immense source of pride for some physicians, as well it should be. However, it can also hinder efforts to enhance educational programming if there is a lack of respect for the experience and expertise of all members of a physician and non-physician educator team. A bias, implicit or explicit, may exist and professional respect and trust may not come easy. Education specialist and technologist need to recognize, be aware of, and successfully manage this potential bias in order to build the needed collaborative relationships for successful curriculum and/or instructional design.

Collaborating with Students

Students enter medical school with varying backgrounds, experiences, and levels of expertise; however, there are several important characteristics of medical students. All medical students have excelled in their academic life prior to matriculation into medical school. The average GPA for matriculates to U.S. medical schools in 2018-2019 was 3.72 (AAMC, 2018). Almost all U.S. medical schools require the Medical College Admission Test (MCAT) prior to admission, and it is used as a standardized measurement when comparing applicants and selecting interviewees. In a survey sent to admission officers at 113 medical schools in 2008, the three most important factors for who to invite to interview were: Cumulative science and math GPA, Cumulative GPA, and MCAT Total scores (Dunleavy, Sondheimer, Castillo-Page, & Bletzinger, 2011). To put this in perspective, the average MCAT score nationwide across 2016, 2017 and 2018 was 500.9. The average MCAT score for matriculates to U.S. medical schools for the 2018-2019 academic year was 511.2 which equates to the 83rd percentile (AAMC, 2018). Incoming medical students are cognizant of the importance of standardized testing, grades and time management; however, nothing can prepare them for the challenges of being a medical student and the high stakes of USMLE Step 1.

Priorities. All students enter medical school with, essentially, one goal: become an excellent doctor in their desired specialty. Throughout the medical education process, many students begin to realize that much of their specialized training and abilities will heavily depend on where they match for residency. That being said, there is often a shift in focus from performing well in class to performing well nationally. Students are aware that, although each residency program has a different subset of criteria, there is one standardized measurement used by all programs.
that has been deemed the most important deciding factor when selecting applicants: the USMLE Step 1 examination.

According to the data published by the National Resident Matching Program (NRMP), the average Step 1 score of U.S. applicants went from 220.4 in 2007 to 230.2 in 2014. While the next data set that charts Match outcomes has not yet been released by the NRMP, the current data suggests that the average Step 1 score is increasing (National Resident Matching Program, 2007; National Resident Matching Program, 2014). Today, a student scoring a 220 would only rank in the 30th percentile, making it much more difficult to compete in the Match, especially when applying for a competitive residency. In the 2018 Residency Director Survey administered by the NRMP, the most cited factor for select- ing applicants to interview was USMLE Step 1 scores (NRMP, 2018). The USMLE has evolved from a benchmark for knowledge required to continue through your MedED into a three-digit number that dramatically limits your specialty choices. With the increasing importance and competitiveness, students often begin Step 1 preparation within the first few months of medical school. Although many medical educators have been through medical school themselves, no one understands the increasingly high stakes of USMLE Step Exams as well as current students.

On the surface, student and faculty goals seem to align. Students wish to become excellent physicians; faculty want to teach and graduate excellent physicians. However, the pathway required to achieve those goals are often perceived as antagonistic by students. Students’ view of USMLE Step exams, as the gatekeeper to their desired specialty/residency, shape very clear learning priorities within the first few months of medical school: (a) USMLE Step 1, (b) Building Curriculum Vita (CV)/Classwork, and (c) Personal Obligations/Wellness. In order to match into a residency program, medical students must also fulfill other requirements beyond doing well on the USMLE Step exams. According to 2018 NRMP’s Charting Outcomes in the match: the mean number of research experiences for students who matched was 3.2, the mean number of volunteer experiences was 7.3, and the mean number of abstracts, presentations, and publications was 5.7 (NRMP, 2018). To build a competitive CV, these activities also need to be completed during medical school while trying to keep up with USMLE Step studying, coursework and personal obligations.

Challenges. While it is well known that medical school is difficult, the only people who truly understand the weight of that difficulty are current medical students or recent medical graduates. The challenges that medical students face can essentially all be related to a balance of time—or lack thereof—and expectations. As technology advances and knowledge continues to accumulate, students and professionals must learn more than ever. Although this is true in every field, it is particularly problematic for medical students who are required to have knowledge of numerous complex fields (i.e. physiology, pathology, psychology, epidemiology, radiology, pharmacology, genetics, and molecular biology). Therefore, each year, the educational expectations grow exponentially for medical students. The sheer amount of medical knowledge has evolved to a point where educators must decide what to teach students in the first two years, sometimes the material aligns well with Step 1 expectations, but other times it does not. This may result in students feeling under-prepared for Step 1 and resorting to outside resources, rather than attending lectures.

As mentioned previously, residency competitiveness is increasing but the time constraints remain the same, making efficiency a major challenge for students. Additionally, the demographics and responsibilities of incoming medical students is changing. Historically, medical students matriculated immediately following completion of their undergraduate degree. However, recent trends indicate that the majority of matriculates (63.3%) are now non-traditional students (Colleges, 2018). For some, non-traditional means taking a year or two for additional work or study experiences; but, for others, it can mean working in another career for almost a decade before deciding to re-enter academia. As the average age of matriculates increases, the number of students with personal or family obligations is increasing. This combination of information overload, required experiences, and personal obligations often leaves students with little time for self-care.

According to a cross-sectional study analyzing data from 4,287 U.S. medical students, there are high rates of burnout, depres-
sion, and suicidal ideation in medical students, with burnout rates reaching 49.6% and suicidal ideation averaging 11.2% (Dyrbye et al., 2008). It is crucial that medical educators consider the tension of balancing expectations and obligations and students’ focus on time-efficiency as these emphasize the importance of curating manageable materials, and represents the factors that impact student engagement, attendance, and performance.

Despite the obvious fact that there is too much information for medical students to learn in such a short amount of time, curriculums have continued to present students with the raw data, expecting them to condense it down alone and still have time to understand its application. Spending hours summarizing information that only boils down to a minuscule portion of what students must know in the grand scheme often drives students away from this inefficient form of learning. What students truly need is for professors and instructional designers to make learning more meaningful and time-efficient by condensing information and curating materials to help students retain and apply the knowledge.

Ideally, from a student’s perspective, MedED might take the following form: provide students with a standardized, efficient method to gain initial exposure to a broad variety of topics. Then, after first-pass learning, help professors use their experiences and expertise to expand upon that information through case examples, simulations, and student-professor interactions. This would help create a shared mental model between professors and students, enabling students to feel confident about their step preparation and professors to feel confident that they are relaying their clinical expertise.

Perceptions of Instructional Designers. Medical students are often so busy that most never interact with faculty, let alone instructional designers. Other than required tutorials or introductions, there is minimal interaction with librarians and educational technology personnel as well. Many medical students are not aware of the purpose of instructional designers and the important role they play in curriculum development. Considering the dissonance between student objectives and curriculum design, from a student perspective, an ideal instructional designer is one who understands medical students’ background and is hyper-aware and understanding of their learning priorities. Furthermore, an ideal instructional designer applies this knowledge to work with students and faculty to curate resources, summarize information, and develop learning objectives that align with student’s learning trajectories.

Collaborating with Administrators

Collaboration between M.D. program administration and the educational faculty is complicated by virtue of the clinical practice model; that is, most of the educators that a medical student will come in contact with are managing an active clinical and, possibly also research portfolio. Although some similarities can be drawn from other disciplines, the immediacy and even urgency of clinical care may trump the best laid plans of medical educators. Administration of the M.D. program takes careful and continuous reassessment of the delivery across all college missions and is frequently managed by faculty and leadership that straddle three different tiers of academic administration: (a) the faculty need to deliver on all missions, including the teaching mission, and are generally assigned a role upon joining a department; (b) the departmental leader, typically a chairperson, still personally contributes to all missions but the administrative role is greater. This administrator assigns roles to faculty that cover a comprehensive slice of a specific discipline to trainees; and finally, (c) the program leadership, in medical schools this is generally an associate dean for education (or, associate dean for curriculum) – this role is generally quite focused. This individual will have little other mission assignment, their focus being to maintain excellence in curricular delivery and maintenance of accreditation. It is important for the education specialist to understand and relate to the tension created in the model: The best teacher may also be the best clinician or researcher and at some point that individual may need either to focus on one area, or be asked to do so in support of their clinical division. Recognizing who has the administrative support for education, as well as the skills and aptitude are an important step in developing the best possible educational team for the MD program.

Education specialists embedded in the MD program can, in fact, become something akin to a talent scout and developer for early faculty who demonstrate excellence in education. Success in all missions is generally a stat-
ed goal in all medical schools; thus, the top-leadership of all schools will state and corroborate that their school aims to succeed in teaching, research and patient care. The general state of affairs is that financing for the educational component of a medical school is generally stable, but also somewhat insufficient to deliver on all of the trainee needs. Research and clinical funding can be greater, but also more volatile and dependent on external factors like governmental funding, or insurance company decisions. Thus, the top brass at a medical school is constantly attempting to balance all of the missions with the needs, and the year-on-year variability of funds. The educational programs, like all programs, will be scrutinized for effectiveness, delivery of promised goals, and overall costs every year. Education specialists are well-positioned to address and represent these points in ways that medical disciplinary experts (e.g., a lung pathology expert) cannot, and this is an area where we believe there is great opportunity for collaboration between education specialists and MD program leadership – that is, formal evaluation of the program in an effort to maintain adequate institutional support for excellence in the educational mission and, inherently, leading to continued accreditation.

It has been our experience that basic and clinical science educators in an MD program will welcome assistance from education specialists, as will program leadership with the following nuances or considerations: (a) The faculty closest to medical students will occasionally have received some formal training in education, through a certificate or even a master’s degree program, though this is still fairly rare; (b) most clinical faculty believe that their ability to teach at the bedside, in the course of their usual clinical work, will translate to teaching in all UME venues but that is not actually our experience; (c) thus, teaching students in a classroom or structured small-group formats will be a greater challenge for the typical clinician-educator than teaching in the course of their daily clinical work; (d) most of us (clinicians included) will continue to repeat what we have seen – and most clinicians currently in practice developed in an era dominated by MS Powerpoint® didactics, and this is where their comfort lies. The educational specialist has a number of opportunities to weave their expertise into the MD program by allying with faculty, elevating their working capacity to teach using a broader range of techniques, and assessing the impact of these interventions on the learner.

Concluding Comments
Medical educators and administrators face many competing demands. The growing complexities of accreditation and credentialing, along with the maintenance and assessment of competencies leave little time for medical school faculty to facilitate institutional management and administration, and advance educational practice, research, and innovation. Education specialists may help faculty address such challenges and provide a cost-effective way to meet many MedED needs, freeing physicians to facilitate high-quality education and supervision of the nation’s medical students and residents. We see such collaboration between medical school faculty and education specialists expanding, based on the numerous publications that have documented the value of nonphysician medical educators in MedED journals, along with increases in related job descriptions (c.f., Riesenberg, Little, & Wright, 2009). However, it remains to be seen whether such alliances will achieve long-term success.

Like Riesenberg, Little and Wright (2009), we also call for outcome studies to further measure the effectiveness of curriculum created by a team of medical school faculty and education specialists. We also call for (design-based research) studies that focus on improving educational products, processes, and policies as well as learning theories and tools. Future studies should address learner engagement, economic efficiency, and the impact of systematically designed instruction on learners and the effects of following a systematic design process on faculty using valid and reliable measures. We hope that education specialists will be among those who seek to conduct such research to advance teaching and learning in medical school settings.

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Teaming up to Improve Medical/Healthcare Education: Instructional Design & Learning Engineering

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Abstract: As medical and healthcare education becomes more complex, especially with respect to data availability and the use of technology, those who teach in the field may find it difficult to keep up with the changes. Instructional Design teams in which Learning Engineering plays a central role can enable medical and healthcare educators to expand their knowledge and skills in education, technology, and data use. This paper describes the composition and expertise of such teams and explores how they can enhance medical and healthcare education.

Keywords: instructional design, learning engineering, collaboration, team, data, instructional technology

Instructional Designers (IDs) share a common grounding in educational sciences, research, and theory. Over time, IDs also develop and refine their skills and knowledge in different areas (e.g., assessment, curriculum development, instructional technology, analytics). An ID’s expertise in one area, however, does not necessarily translate directly to expertise in another area, and even within one area, different IDs can have different capabilities. To be successful working in medical and healthcare education (M/HE), IDs can also develop additional skill sets in such areas as simulation, interprofessional education, and communication in healthcare settings, that are not covered in most traditional instructional design programs. Attaining and maintaining these skills adds complexity to the job of the ID and their growth and development.

Many different terms and titles have been used, sometimes interchangeably, to describe what IDs do in the field (e.g., instructional systems designer, curriculum builder, educational technologist). Now, however, a new term is entering into this complex field: Learning Engineering. Though the concept of the learning engineer was first mentioned in the 1960s by Herbert Simon, it has seen a renewed surge in interest over the last 10 years. Education professionals are asking questions such as: What makes up expertise in Learning Engineering? How do Learning Engineering skills relate to, expand upon or differ from the skills of IDs in a variety of fields, including M/HE? “Instructional Designer” is a role that many outside of the field have a hard time comprehending, and the emergence of the concept of Learning Engineering can generate additional confusion. This paper will briefly describe the current professional identity of the ID and explore the composition of Instructional Design teams, and examine how Learning Engineering can be incorporated into those teams in ways that enhance the ability to sup-
port teaching and learning effectively. The paper will delineate the need for seeing the teams as integral parts of the educational process for them to provide the most effective support for M/HE, and provides examples of what such support could look like.

**Instructional Design Activities in Higher Education**

One key element of the ID role throughout its history has been to help connect faculty and other educators to best practices in instruction, teaching and learning, and, later, instructional technology. IDs working in a variety of arenas tend to have common foundations on which they can build, and many develop specialized knowledge when working in a specific field such as M/HE. Campbell, Schwier, and Kenny (2009) state that IDs work directly with faculty to help them think more critically about a range of issues related to instruction, including the needs of learners, curriculum, learning environments, policy development, etc. Another field that is highly relevant to IDs is “learning sciences,” which is an interdisciplinary field that works to further scientific understanding of learning in all environments which learning occurs (Merrill, Drake, Lacy & Pratt, 1996). The empirical and theoretical underpinnings of neuroscience, cognitive science, instructional design, data analytics, computer science, psychology, user interface design, education/training, and many others have formed the foundation of the discipline.

Even as Instructional Design teams incorporate skills and research from a wide variety of fields into their work, they must also be able to explain those decisions in ways that make sense to the faculty members with whom they are working. Campbell et al. (2009) suggest that “Clients working with instructional designers in educational projects are actually engaging, as learners, in a process of professional and personal transformation that has the potential to transform the participants and the institution” (p. 646). Thus, IDs are most effective when they serve as instructors in interactions with a client and can adapt their approach to the needs of the client.

The relationship of IDs to their primary role of supporting instruction and learning is premised on the fact that many IDs are also educators, and that good teaching and learning practices are the primary focus of their work. Many researchers on effective teaching and learning (Anderson & Carta-Falsa, 2002; Darling-Hammond, 2005; Gage, 1989; Seidel & Shavelson, 2007) express what those in the education field have known for decades: Teaching is a complex activity, and effective teaching is closely tied to the success of learners (Angelo & Cross, 1993; Dick & Carey, 1990; Kern, Thomas, & Hughes, 2009, Shulman, 1999; Sorcinelli, Austin, Eddy & Beach, 2006).

Given the complexity of teaching and learning, instructional designers can amplify the effects of their interventions by working as part of a multifaceted team (Crowley, Chen and Cerver, 2018; Hixon, 2008; Rowley, Bunker and Cole (2002), as cited in Kenny, Zhang, Schwier and Campbell, 2005). The benefits of working in teams is especially pronounced in a specialized field like M/HE. In many environments, the ID collaborates with other learning professionals (e.g., graphic designers, software or application developers, subject matter experts, faculty, medical illustrators, etc.) to create a strong educational product. In such cases the ID frequently serves as a project manager, and the team can be considered an Instructional Design team. Like the director of a movie, an experienced ID guides the theoretical, artistic and technical aspects of a project, visualizing the end state while guiding the entire team in the fulfillment of that vision.

The specific role Instructional Design team members will play on any project depends on the objectives of the project but also on their experience and expertise. The foundation for members of the team lies in their academic preparation, which introduces them to theories, models, and the systematic approaches unique to their specialty. Instructional Design teams must work together to conceptualize and plan products. In a team environment, each of the members of the team take on different roles or tasks. For example, IDs might research new innovations in both learning design and education and apply theoretical models of learning into the design of educational/training products; instructional technologists, graphic artists and medical illustrators might develop educational materials (using both high technology and low/no technology approaches); curriculum specialists might evaluate products; and training specialists might provide professional development sessions on how to use the products effectively. In Instructional Design team work, there are
few situations with only a single right answer, and a learning/instructional problem can be solved in many ways. The background and training of Instructional Design teams helps them identify the range of possible solutions and also select one that will be effective. McDonald (2011) quotes Nigel Cross as stating that, for the ID: "Designing is a process of pattern synthesis, rather than pattern recognition. The solution is not simply lying there among the data... it has to be actively constructed by the designer's own efforts" (p. 24).

Instructional Design team members need to have a familiarity with current theory, data, and research in each of their fields to provide effective services as described above, and they also need to be well-versed in the growing world of technology as an implementation tool. It is also helpful if the Instructional Design team members have an institutional understanding of the environment in which the educational product will be placed.

Enter Learning Engineering

In the complex, dynamic environment described above, a new term has come into play: Learning Engineering. In December of 2017, the Institute of Electrical and Electronics Engineers (IEEE) Standards Board recommended the creation of a new 24 month activity to provide definition to and support for the burgeoning field of Learning Engineering. In 2019, this activity was renewed for another 24 months until 2021.

Learning Engineering is an interdisciplinary approach based on an in-depth foundation and education in proven theoretical models and methods, educational paradigms and approaches, and methods of science and data (Lieberman, 2018; Educause Learning Initiative, 2018). The IEEE Industry Connections Industry Consortium on Learning Engineering (ICICLE) Competencies, Curriculum, and Credentials (CCC) Special Interest Group (SIG) states that:

Learning Engineering is a process and practice that
1. applies the learning sciences,
2. using human-centered engineering design methodologies, and
3. data-informed decision making to support learners and their development. (IEEE CCC SIG, 2019)

Learning Engineering, like Instructional Design, needs to be grounded in learning science, applying existing science and generating data to improve, achieve, and even transform learning outcomes. However, the emerging field of Learning Engineering provides a more focused emphasis on big data, using validated methods that put large amounts of educational data to work in the service of improved student success and institutional effectiveness (Lieberman, 2018). Learning Engineering incorporates knowledge of what makes good learning design but also may encompass innovation, learning science, learning analytics, data visualization, data modeling, and enterprise learning technologies (how to scale innovations across the learning ecosystem).

There is some debate about the extent to which Learning Engineering overlaps with Instructional Design, since it is possible for an ID with research and experience to gain expertise in the areas sometimes seen as unique to Learning Engineering. One distinguishing element of Learning Engineering is the academic preparation and the grounding of its practice, with an approach that focused more on big data, using statistical modeling approaches for analyzing and visualizing large datasets, or detailed analysis of educational standards, to improve learning. Befitting the word “engineer,” they tend to use computer science as well as engineering processes in identifying and/or solving problems. Learning Engineering can thus be placed amongst the professions, where people can have a background in a professional field, such as analytics, but also can be a learning engineer within that field because they fill that role on a learning support team.

The Evolution of Instructional Design Teams

As the amount and type of data available grow, the potential benefits of using that data in instructional planning increase, and the possible applications of enterprise technology in teaching and learning expand. In this environment, incorporating a Learning Engineering approach into the Instructional Design team shows substantial promise, especially in a technical field like M/HE where evidence and data-based decision making are crucial. Bringing together the ID, graphic designer, videographer, technology specialists, simulation expert, medical illustrator, etc. along with,
say, an expert in data analytics, to solve educational challenges starts our journey of reimagining the future and roles of faculty support teams.

Learning Engineering teams would focus on the use of big data and data analytics, visualization and modeling, and enterprise technologies. Implementing technology is not the goal of Learning Engineering teams—good instruction and learning are the focus. One important factor to recognize is that in a team environment members of one team may work with or be a subset of another. A typical alignment for a Learning Engineering team may be a subset of the Instructional Design team, given the distinguishing elements of the roles and the overarching team’s attention to teaching and learning. The focus here is less on what individual people do when they carry out a project, and more on what it means to be part of a team and participate in the culture of support for education, technology, curriculum, teaching, data, learning, etc.

An exploration of the appropriate use of teams can provide insight into ways that they can be successful in M/HE settings. First, let’s examine the role of teams in the curriculum or course design and development process. Teams are likely to work on a variety of projects; they can focus on supporting one faculty member, an entire department, a school, or the leadership at the department, school or university level. Yet the way that these teams are viewed within the university system can have a substantial impact on the work they can do. While these teams serve many roles in the educational landscape, many people in the educational environment still see them as an extension of technology support and the help desk, rather than as credentialed teaching and learning professionals. This misapprehension can lead to situations in which people come to the learning support teams for “just-in-time” support rather than on a timeline that allows analysis and planning. As an example, instructional designers surveyed by Intentional Futures identified “struggling to collaborate with faculty” as their top challenge, followed by lack of time and resources (Intentional Futures, 2016). Collaboration and partnership between educators and IDs have not yet become commonplace, and there remains much uncharted territory. In part, IDs point to a misconception held by many faculty members that online learning works using a “set it and forget it” approach (Intentional Futures, 2016, p. 3), suggesting that instructional design work can be done once and does not require ongoing evaluation and modification.

**Setting up Instructional Design and Learning Engineering Teams for Success in M/HE**

So, how can these Instructional Design and Learning Engineering teams contribute to M/HE? The importance of specialized teaching and learning support in M/HE can be seen through a review of the Liaison Committee on Medical Education (LCME) documentation on accreditation, which lays out the “Function and Structure” required in an accredited medical school. There are 12 comprehensive standards covering many aspects of roles IDs provide, such as providing appropriate, information technology resources/staff, resources, including opportunities for self-directed learning; preparing students for lifelong learning; allowing for ongoing monitoring, review and revision of instructional objectives; and giving students “opportunities to learn in academic environments that permit interaction with students enrolled in other health professions, graduate and professional degree programs, and in clinical environments that provide opportunities for interaction with physicians in graduate medical education programs and in continuing medical education programs” (AAMC & AMA, 2019, p. 9).

The grounding elements of curricular design and management, the systematic review and critical appraisal of the quality of existing materials, and a theoretical and practical understanding of innovation related to the use of data, which AAMC and AMA articulated as key functions of a medical school, are central to the work of both teams. These teams can be involved with the entire instructional process or with portions of it in their interactions with clients. Using research and theory to inform decision-making that supports learning, Learning Engineering and Instructional Design teams will work to ensure solid analysis takes place before design and development occur. Knowing the significance of goals and objectives in the medical school accreditation process, specialized teams will also emphasize the importance of evaluation to ensure goals are met.

Faculty members in the M/HE realm already seek specialized teaching and learning
services. Anderson, Love and Haggar (2019) conducted a survey of self-identified instructional designers working in medical education, receiving 72 responses. The responses to the survey give a good sense of the variety of roles instructional designers play in M/HE.

They spend the majority of their time advising faculty on pedagogy and teaching best practices (n = 59, 82%), followed by developing professional development training (n = 55, 76%), advising faculty or staff on how to use educational technology (n = 54, 75%), and designing/building e-learning modules for subject matter experts (n = 52, 72%)" (p. 509). While IDs work closely with faculty, they also work with non-academic staff and other IDs multiple times a week and work with both information technology specialists and senior leaders/administrators once a week on average. IDs also occasionally work with external educational technology providers, students, and librarians. (p. 509)

As discussed previously, Learning Engineering team members can bring additional skillsets that would be of use to medical educators, such as data analysis and visualization.

For Instructional Design and Learning Engineering teams to help generate the desired instructional outcomes, they must be seen as integral parts of the educational process rather than troubleshooters, which changes the entire learning community of an organization. Such an organization emphasizes partnership as the foundation of the working relationship between learning support teams and faculty members, and value educational expertise as much as subject matter expertise. The best support comes from the collaborative nature of the exchanges between and amongst the educators. Wenger (2000) helps us understand the importance of setting up relationships of collaboration and partnership within the learning community. He explains that members of a community come together when they pursue shared interests and engage in activities and discussions together, helping each other and sharing information that enables them to learn from one another. Several studies offer examples of partnerships between IDs and educators (e.g., Byun, Hallett, & Essex, 2000; Meyen, Tangen, & Lian, 1999; Wright & Miller, 2000). Qualities for IDs such as mentoring, sensitivity, the ability to suspend judgment, rapport building, goal setting, providing feedback, and monitoring can help them foster and thrive in a collaborative environment. The findings of Anderson, et al., (2019), as described above, make clear that the need for collaboration between faculty/staff and learning specialists has broadened substantially in the area of technology, and it now encompasses many more aspects than its creators could have foreseen.

As a hypothetical example, consider a new assistant professor in a Radiology department who is asked to teach an existing classroom-based course on Nuclear Medicine, and also to enhance an online version of that course. This professor might initially seek out information from the Instructional Design team about how to modify the syllabus in the learning management system (LMS) or how to upload recorded lectures into the LMS, but also be put in touch with members from the Learning Engineering team to take a deep look at the data on student learning within the various course offerings, which might lead the professor to want to make additional enhancements. For example, the Learning Engineering team could work with the professor to gather information about what course resources are used when and by whom from the university’s LMS and video streaming server, and could analyze it and map it to data provided by students in responses to a survey, or to test results. The professor might then choose to work with members of the Video Production or Development team to develop different types of interventions (shorter topic-based videos, or text pieces instead of long full lecture videos) and deploy those new versions at different times throughout the semester, or to different groups of students, in order to support all students in meeting both the course objectives and their individual learning goals. The larger Instructional Design team might also work collaboratively to develop a dashboard (using data analytics experts, developers, graphic artists, instructional designers, and user interface specialists) to develop a product that would allow the instructor to monitor relevant information during the semester and add resources when they are needed.

Learning Engineering teams could also support M/HE faculty who want to take advantage of the growing amount of data available to them. In 2012, Beath, Becerra-
Fernandez, Ross, and Short (2012) stated that “in most organizations the volume of data is expanding by 35%-50% every year - and this number could be even greater now”. This growth of data highlights the benefits a Learning Engineering approach to help learning teams determine how to use that data, along with insights from learning science, to improve and enhance learning in M/HE programs. For example, a Learning Engineering team could help a department identify which students are struggling in which portions of the curriculum, and then work with other members of the Instructional Design team to design and develop appropriate interventions to support those students (at the individual or group level), and examine which of those interventions were the most successful.

Finally, Learning Engineering teams could help M/HE faculty and staff keep up with trends in data and emerging technology. Robin, McNeil, Cook, Agarwal, and Singhal (2011) discuss how technology and education have evolved and changed our thinking and practice in M/HE in numerous ways, while also highlighting the trends that suggest that we must adapt our instructional strategies to adequately educate the next generation of health care professionals. One example is the growing use of simulation and virtual reality/augmented reality (VR/AR) in M/HE. Students are using human cadavers less and increasing use of VR/AR and simulation. The information provided by these environments requires entirely new ways of thinking about instructional strategies, exercise development, assessment and evaluation. Learning Engineering and Instructional Design team members can collaborate with faculty to envision them in new and different ways.

Conclusion & Recommendations

As M/HE grows and becomes more complex, those who teach in the field may well find it difficult to keep up with the changes. Instructional Design and Learning Engineering teams will bring together specialists in the realm of education who can help those who are teaching to transform learning environments for their students and to expand their own knowledge and skills in the use of best practices and education. Instructional Design and Learning Engineering teams supporting M/HE should be made up of many professionals, who have differing expertise (though there may be some overlap among team members) and a strong grounding in teamwork, problem solving, and collaboration. As the positions and teams evolve going forward, we need to be sure that support teams working at the same institution have clearly defined roles, responsibilities, and understandings of collaboration so that both they and the University personnel with whom they work know whom to approach for different needs.

The combination of knowledge and experience, with the ability to filter knowledge through the lens of experience, characterizes the Instructional Design and Learning Engineering teams’ approaches to instructional solutions in M/HE. The value of these teams in M/HE environments does not lie entirely in their current individual abilities, but also in their ability to grow and develop their individual expertise areas and address the volume of data, research, and competencies that are growing in M/HE. They bring the greatest strength when they are working in team environments, bringing the highest levels of knowledge and experience in a particular area to solve a particular challenge for the team.

Teams supporting education and technology use in M/HE are likely to continue to develop and build as academic disciplines, certificates, competency boards and programs get engaged in the conversation, but we must ensure that the knowledge and ability to work in teams, collaborate with others, support innovation, and implement change is at the heart of any efforts. We must also ensure that those in charge of instruction and leadership in those organizations recognize the benefits of the teams that bring together various expertise, and thus ensure that they play an active and valued role in the community/team and in the educational process.

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Storytelling Strategies for the Design of Branching Virtual Patient Simulations

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Abstract: Virtual patient (VP) simulations are online learning and assessment experiences that simulate authentic patient encounters. By immersing participants within an engaging story about the patient’s illness journey, VP simulations promote effective learning and the development of empathetic healthcare. A primary strategy for designing VP simulations is to integrate the art of storytelling with the science of instructional design to build clinical stories that strategically align learning objectives with decision points, consequences, coaching, and performance metrics. Through this integrated approach, the simulation facilitates the process of discovering insights, so that learners are better equipped to apply their skills in the real world.

Keywords: clinical, decision making, storytelling, story, instructional design, virtual patient, simulation, thick, rich, narrative, branch(ed), branch(ing).

Storytelling Strategies for the Design of Branching Virtual Patient Simulations

People have been telling stories for generations. A captivating story engages both our hearts and our minds as we escape into another world. While using narratives in medical education may seem frivolously whimsical, when crafted deliberately and told strategically, stories can affect us emotionally and thereby have the power to imprint new life lessons and new concepts into our mental schemata.

The design of effective and engaging learning experiences within healthcare and life sciences can harness the power of storytelling to assess and develop a wide variety of skills, including: clinical decision-making, communication, providing empathetic patient care, and even pharmaceutical sales consulting—just to name a few. The critical task is to align the creative narrative with the learning objectives, activities, and assessments so that participants are guided towards the targeted clinical insights. Though stated simply, the process for designing and developing highly complex clinical information into strategic patient journeys that facilitate new learning is not as easy as it may seem. It requires that the design team think through each piece of content systematically and to analyze how each component and decision will affect the holistic, learning experience. That is, we have to think both systematically and systemically while being creative storytellers.

This article explores strategies, practices, and principles that both instructional designers and healthcare professionals can use to harness storytelling within the context of online simulations. While this discussion is about eLearning, many of the strategies presented in this article can be applied to other
types of learning environments, including facilitator led instruction and live simulations with mannequins, task trainers, and standardized patients.

To situate the exploration of strategies and principles, the discussion begins with a brief review of the use of VP stimulations to facilitate clinical decision-making. Then, the article explains how grounded learning theory may form the foundation of healthcare simulations. Grounded learning theory will then be used to explore strategies and models for designing and developing online simulations. The remaining sections explore examples of sample simulation pathways that are often used in healthcare simulations, as well as two simulations that were created by a team including an instructional designer and professional clinicians.

Clinical Decision-Making and Virtual Patient Simulations

Decision-making is at the very core of the wellness journey for the entire healthcare team including providers and patients. For both clinicians and patients, the ultimate goal of sharing and analyzing information is to make decisions that will help patients maintain and improve their health. Therefore, when creating learning experiences that guide clinicians (and patients) towards insights about these healthcare journeys, decision-making should be at the forefront of design and development.

Both experts and novices, in a variety of contexts including medicine, use stories to make sense of complex, ill-structured information and to evaluate alternative decision and outcome options (Jonassen, 2011). In clinical decision-making, experienced healthcare providers use their mental library of illness scripts to diagnose patients (Bizzocchi & Schell, 2009; Jonassen, 2011). These schemata are memories of clinical domain knowledge and contextual information that provide roadmaps for determining the diagnosis and for evaluating treatment options (Jonassen, 2011; Schmidt & Boshuizen, 1993). In contrast, novice healthcare providers have fewer illness scripts, and therefore, must rely upon their conceptual, scientific knowledge. It is through clinical experience and deliberate practice, that providers build their mental library of illness scripts (Ericsson, 2008).

Bizzocchi and Schell (2009) suggest that clinical training should provide a balance of both rich and thin narrative cases. Rich narrative cases are immersive experiences that include well-developed stories and rich media elements. In these stories, learners experience the healthcare journey from the patient’s perspective as they describe, in their own words, their symptoms, challenges, and concerns. This storytelling approach has two advantages: it supports learning and provides a more holistic patient-centered approach to healthcare (Bizzocchi & Schell, 2009, p.1414). Conversely, thin narrative cases are a more traditional approach that provide brief clinical summaries from the provider’s perspective; they are typically written in the third person singular and lack character development. Bizzocchi and Schell recommend using more rich narrative cases earlier in clinical training to improve learning and to promote empathetic care. As learners progress, the curriculum can switch to the inclusion of more thin cases to support the development of a mental library of illness scripts through deliberate practice (Ericsson, 2008).

Virtual patient simulations use storytelling to create rich, branched learning experiences for clinical decision-making and for healthcare communication skills. Virtual patients are online learning and assessment experiences that simulate real life patient encounters (Bateman, Allen, Samani, Kidd, a& Davies, 2013; Cook & Triola, 2009; Hirumi, et al., 2018). They involve learners (both experienced and inexperienced) in the following tasks: reviewing the patient history, conducting the patient interview, ordering labs and imaging studies, forming a clinical diagnosis, recommending treatment options, managing complications, and communicating with other clinicians and patients (McGee, 2014).

Storytelling techniques that integrate creative writing with rich media supports learning by organizing information in authentic contexts and by promoting emotional engagement (Branaghan, 2010; Rock, 2009; Spero, 2012). When learners become immersed in the strategic story they are better able to retain, retrieve, and apply the knowledge and information they discover. The emotional aspect of the conflict and the resolution that is inherent in the very structure of stories support the movement of information from short term to long term memory (Spero, 2012). The emotional memories of these narrative experiences are more easily encoded
Grounded Theory for Designing Rich Narrative VP Simulations

The use of rich narrative VP simulations in healthcare learning experiences is well established. However, creating these simulations has its own unique challenges and there is little guidance on effective strategies for their design. One of these challenges relates to the fact that instructional designers need to be both analytical and creative. Both of these skills are needed to design and develop strategic learning stories that immerse participants in an engaging story, that guides them towards the targeted insights, and that collects the desired data (Kapp, 2013, p. 6). Not just any story will work; the story, along with its decision points and branching pathways, must be aligned with the learning objectives. Yet, as Kapp states, many instructional designers are more comfortable with the analytical task of creating learning experiences to ensure alignment between the learning objectives, activities, and assessments. Some instructional designers may not be as comfortable with writing fictional stories that are aligned with the desired design; additionally, many designers may not be comfortable with learning complex, clinical content quickly and with viewing medically graphic media. The critical task is to create an engaging strategic story that meets the clinical learning objectives and that collects the desired performance related data.

Recently, a grounded theory for VP simulation design was proposed (Batemen, Allen, Samani, Kidd, & Davies, 2013, p. 599). In the virtual patient construction component of this model, there are several elements to consider while designing these instructional simulations:

- **Real Life:** how realistically the experience portrays the healthcare setting
- **Pathway Flux:** how clinical information is presented, and the degree of freedom learners have regarding the case progression
- **Feedback:** how feedback is delivered
- **Decision Flux:** the freedom learners have to make decisions, including optimal, suboptimal and poo
- **Consequence Effect:** the extent to which learners experience the outcomes of their decisions.

Delivering feedback can be separated into two categories: consequences and judgments (Allen, 2012, p. 27). To create an authentic experience, it’s wise to follow a simple strategy, “When in story, stay in story.” That is, learners should first experience the consequences of their decisions within the narrative before receiving coaching--outside of the narrative--that fosters reflection about their performance (Allen, 2012). In fact, the act of providing feedback creates a threat response that prevents performance improvement (Rock, 2009). A better approach is to guide learners to discover their own insights by enabling them to make decisions, observe the consequences, and then reflect upon the action that caused the outcome. “Real change happens when people see things they have not seen before” (Rock, 2009, p. 218).

To foster self-reflection, online coaches or mentors can be created to simulate a cognitive apprenticeship (Dennen, 2004). A qualitative research study conducted with a VP simulation found that learners reported “…greater confidence in their understanding of feedback received from a mentor” than from anonymous feedback delivered via non-narrative assessment questions (Schladen, 2015, p. 242).

The mentor can be an actual expert in the field or a fictionalized person. This online mentor can be portrayed through a variety of media treatments, such as photos, text, audio, or video. Typically, the mentor opens the simulation, provides just in time coaching within the simulation, and then guides reflection at the conclusion of the simulation. Feedback can be provided immediately after a decision/consequence sequence, or it might be delayed until the completion of the simulation. If feedback is delayed, then it is critical for the mentor to foster the connection of the decision to the associated outcome. Otherwise, learners may not identify which decision caused the consequence, and then will not arrive at the targeted insight.

When creating branched simulations (whether or not they are healthcare related), instructional designers, along with other members of the team, have to balance all of these considerations including: creating an engaging story that simulates an authentic context, determining the degree of freedom learners will have over the simulation flow, the type and

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timing of feedback, and the use of a mentor. Additional considerations are: the level of interactivity and richness of media, the type of assessment data required from the simulation, the implementation requirements, and the resource constraints for design and development.

For VP simulations, there are additional factors to consider: the balance of providing complex clinical information with creating a streamlined learning experience, portraying patients with realistic dialogue and behaviors, including authentic alternate outcomes, and crafting coaching from a credible mentor who provides sufficient clinical information without causing cognitive overload.

To meet these needs, the design process tends to use an agile approach with short iterative phases of needs analysis, design, and development (Allen, 2012). To ground the project, a brief analysis is conducted to determine the need, goals and objectives, assessment and data requirements, as well as technical considerations. From there, storyboarding begins by working with one or two subject matter experts to identify the simulation flow. The process begins by identifying the decision points that relate to the objectives; this defines the branches, as well as the coaching touchpoints and performance-based data collection opportunities. Through successive iterations, the simulation is then designed, developed, and evaluated until the it reaches to completion.

**Clinical Decision-Making Branching Designs**

To demonstrate how branching can be incorporated into VP simulations, this section explores several possible diverging designs that often occur in healthcare simulations. Each of these designs offer different opportunities for crafting a clinical story, enabling more or less learner narrative control, and for providing unique strategies to provide coaching and to promote reflection. The design formats also engage learners within the emotional context of a story, thereby promoting the retention and retrieval of new illness scripts.

**Alternate Versus Single Outcomes**

While each VP simulation has a unique story and flow that meets the targeted learning goals, there are several branching formats that recur throughout the designs. For example, in clinical decision-making, quite often there are similar steps, including reviewing the patient history, conducting the patient interview, forming a differential diagnosis, ordering labs and imaging studies, formulating a diagnosis, and recommending treatment options. Some simulations may also include following up with the patient throughout the treatment process to manage any complications. To meet patients’ needs, the simulation will have alternate patient outcomes including: poor, suboptimal, or optimal (Figure 1). Note: Each rectangle in Figure 1 represents a screen in the simulation.

With the alternate outcomes, learners progress through the case much as they would in a real-world context. The story begins with the patient history. To ensure authenticity, the health records can simulate the format that providers would review in their actual practice. As learners work through the case, they operate independently without coaching. They make decisions about what questions to ask the patient, the labs and imaging studies to or-

![Figure 1. Simulation flow for enabling alternative outcomes](image)
Understand the procedure and determine the diagnosis. After recommending treatment, the simulation moves forward in time and the learners see an update from the patient. Depending upon the efficacy of their choices, learners may see an optimal, suboptimal, or a poor outcome. For example, the patient may have symptom relief with few complications (optimal); the patient may feel better but may have encountered some avoidable negative consequences (suboptimal); or the patient may have suffered a severe complication (poor). The outcome may be the result of one or several choices that occurred earlier in the simulation; therefore, the consequences and feedback might be delayed. Or they could be a result of the treatment option only. It depends upon the objectives of the simulation.

Only after observing this real-world consequence, does the mentor return to promote self-reflection. This can begin with a more global discussion and then can continue in a more granular level. For example, the coach can discuss the learners’ individual choices, including whether or not they identified the most accurate diagnosis, ordered the preferred labs and imaging studies, and to what extent they utilized resources efficiently. A benefit to this approach is that learners progress uninterrupted throughout the simulation, much as they would in the real world. However, since feedback is delayed it is critical to provide sufficient coaching at the end of the simulation to ensure that learners correlate their choices to the patient outcome.

In other situations, it may be important for learners to discover the optimal solution before progressing in the simulation (Figure 2). In this design, after seeing a poor outcome, learners immediately reflect with the help of their coach. For example, in this fictional case, the disposition decision was to send the patient home rather than to the emergency department (the optimal decision). As the story continues, the patient returns home and subsequently dies. With such an egregious outcome, the story is suspended and the mentor facilitates reflection immediately. Then time is reset, and learners return to the decision point to make a different decision. In this case, there are just two branches. However, there could be additional branches. A benefit to this flow is that learners receive immediate coaching after making a poor decision. A risk is that the story is suspended and this may impede engagement.

To avoid overwhelming learners and to reduce development time, one general guideline is to limit branching to a maximum of three or four alternate pathways. Too many pathways can cause cognitive overload for learners by having to weigh the benefits and risks of multiple options. Additionally, if learners can only progress after selecting the optimal decision, having many alternate paths may frustrate the learners who choose most or all suboptimal paths prior to selecting the optimal choice. Research supports the reduction of branching options. Rock (2009) states that the optimal number of choices to select from while deciding is two. However, from a data analysis perspective limiting the design to two branches provides participants with a fifty percent chance of selecting an optimal branch. Therefore, using three branches can provide a balance between offering options and avoiding higher levels of complexity—both for simulation development and for the learning experience.

Figure 2. Simulation flow for discovering an optimal approach
Using the VP construction model described above, these two simulation designs have the benefit of realistically portraying the healthcare setting, providing learners with high degrees of decision flux, and providing consequences. However, the pathway flux is limited since learners are guided through the flow of the simulation and do not have control about when they review specific information.

**Exploring Alternative Optimal Approaches**

While the branching designs previously discussed portray healthcare outcomes ranging from optimal to poor, the emphasis of VP simulations is not always about avoiding bad decisions; instead, often times the goal is to explore several optimal approaches. For example, practicing physicians may have differing viewpoints on the best approach, and there is no inherently wrong approach. In these situations, a VP simulation can be developed to gather information about what decisions experts would make for a specific case and to begin a dialogue about the benefits and challenges of various options (Figure 3).

The result for physicians is an opportunity to explore the different approaches and observe short videotaped panel discussions from experts—all within the context of a specific patient. It is the specific illness script that frames the conversation about the various treatment options. Additionally, the simulation can collect data about which approaches are being chosen more frequently. Open and closed ended questions can be included in the simulation for physician participants to explain or select their rationale.

In the Exploring Optimal Approaches design, it is important to present the case and ask any rationale-based questions prior to sharing panel discussions to avoid biasing the data. Additionally, using a blended approach, the online simulation can be followed by a live event with a panel discussion in which experts share data from the simulation and debate the case in further detail.

**Real World Examples: Exploring Two Branching VP Simulations**

While the previous section presented branching designs that are often used in VP simulations, this section presents two case studies with custom designed VP simulations: one simulation focuses on clinical decision-making, and the other simulation addresses clinician-to-clinician communication skills.

**Kaiser Permanente: Assessing and Developing Clinical Decision-Making**

In a branched VP simulation designed

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1 Funded by Decision Simulation Virtual Patient Lokahi Grant from Kaiser Permanente.
and developed with Kaiser Permanente for continuing medical education, practicing physicians diagnose and treat a patient who is having leg pain. Using an alternate outcome branching design, physicians complete their work up prior to receiving a patient update (Figure 4). The last section of the simulation consists of a series of coaching screens in which the mentor guides reflection about a variety of choices relating to the case. Rather than following a linear case flow, this simulation provides physicians more control over the simulation pathway. That is, providers decide what information they wish to review and in what sequence.

For example, in the Next Step sequence (Figure 5) physicians select from list of tasks including ordering imaging studies and labs, seeking consults, and utilizing online diagnostic tools. The simulation limits physicians to ordering just one advanced imaging study since the patient is waiting for results. If they attempt to order a second study, the simulation provides a statement from the patient who is noticeably frustrated and refuses to wait several hours for an additional testing.

The simulation depicted in Figures 4 and 5 branches further based upon whether or not physicians order at least one imaging study. If they do not place any imaging orders, physicians remain on the suboptimal path (Screens 10 – 16). Even on this suboptimal path, there is an optimal, suboptimal, or poor outcome depending upon the physician’s selections regarding treatment and disposition decisions. If, however, they do order one of the four imaging studies, the simulation branches down to a different pathway. As the story continues, the physicians’ treatment and disposition decisions still determine which of the three alternative outcomes will occur. The outcomes range from a brief two-day hospitalization with a full recovery to a 19-day hospitalization.
with intubation (Figure 6). By simulating various patient outcomes, this simulation engages participants emotionally in the story and thereby supports learning through the addition of a new illness script in the physician’s mental database of clinical patient stories.

A design consideration for this simulation was the need to balance the production of rich media while staying within the scope of available resources. The solution was to develop media in-house and to use a few short video and audio clips to augment the custom photography. This approach used higher level media strategically, including a video welcome from the mentor, and an audio clip of the patient.

The assessment data from this simulation are robust, including information about learner selections relating to imaging and lab orders, diagnostic accuracy, treatment initiation, disposition decision, and resource utilization efficiency. Additionally, after the diagnosis selection, physicians are asked to self-report confidence levels in their diagnosis. This enables Kaiser Permanente to compare physicians’ diagnostic accuracy with their self-reported confidence levels, and was based upon a research study which found that “…physicians’ level of confidence may be relatively insensitive to both diagnostic accuracy and case difficulty” (Meyer, Payne, Meeks, Rao, & Singh, 2013, Abstract). Both learners and the organization gain insights from these data. Physicians receive a personalized coaching report comparing their performance on key metrics to those of their peers; and the organization receives data dashboards with both individual and aggregate performance data.

The Veterans Administration: Healthcare Communication Assessment and Development

Virtual patient simulations can also be used to assess and develop clinician-to-clinician and clinician-to-patient communication skills. The Veterans Administration (VA) created a rich narrative, video-based VP simulation for continuing medical education to assess and develop nurses’ implementation of the SBAR model. This model structures communication between clinicians to ensure that critical information is shared efficiently and effectively (Engard, 2016). The format summarizes the following patient-related information: situation (S) background (B), assess-

Figure 6. Screen excerpts of the optimal and poor outcomes

Ms. Montgomery was admitted to the hospital for observation. An echo was normal. She was released after 2 days.

The following day, Ms. Montgomery experienced acute onset of chest pain. She decided to continue on to work and experienced shortness of breath. On the fourth day, one of her co-workers called 911.

She was brought to the ED in acute respiratory distress and was intubated on arrival. Ms. Montgomery eventually recovered, but required 19 days of hospital care.
For this simulation, the VA’s goal was to get a baseline measurement of how many nurses used SBAR without being prompted and their skill level in using the model when prompted. Additionally, the VA wanted to provide nurses with coaching to develop their proficiency with this communication model. To ensure that nurses were unaware of the goal, the simulation situates learners within the story of a patient who is suffering from cancer related pain. Through the context of managing the patient’s symptoms, the simulation assesses SBAR skills both quantitatively and qualitatively, provides performance-based coaching, and then engages nurses in a second opportunity to apply their skills.

Figure 7 provides a brief excerpt from the beginning of the simulation. After calling the patient (Mr. Jackson), nurses are asked to summarize their findings by typing an open-ended response (Figure 7, Screen 02 and Figure 8).

The subsequent screen (Screen 03) provides a list of closed-ended SBAR phrases. Each phrase uses one of the four statement types (situation, background, assessment or recommendation). Nurses are instructed to select all of the phrases they will include in their statement. A total of seven statements are presented to the learners, including an incorrect assessment and an incorrect recommendation statement.

Based upon their selection, the story continues with a video clip of a conversation between the nurse and Dr. Morrison. Learners who have a perfect score, progress to see an exemplar video modeling the targeted SBAR communication skill (Screen 11). For learners who require coaching, the physician provides...
feedback within the context of the story along three branches:

- **Missed SBAR**: Review the importance of all four phases
- **Chose an incorrect statement(s)**: RemEDIATE the incorrect choice selection
- **Missed SBAR and chose incorrect statement(s)**: Reinforce SBAR and remediate the incorrect selection.

For example, the physician responds with irritation and confusion if there is no situation or background included in the statement. If an incorrect statement is included, the physician explains the research behind why that was not the best approach.

Next, learners proceed to a coaching screen in which the online mentor provides personalized feedback based upon their implementation of the SBAR model. Finally, all learners proceed to the modeling SBAR screen in which they can watch an exemplar demonstration of the targeted skill. Later in the simulation, nurses have a second chance to apply the SBAR model by typing their summary and selecting phrases. This approach achieves the goal of assessing and developing the target communication skill, all within the authentic context of the case. The emotional response from the physician helps reinforce learning, and the specific feedback form the mentor provides modeling and coaching to improve performance.

Two design considerations were managed during development. First, the inclusion of seven phrases was visually busy and could have caused cognitive overload. This risk was managed by arranging the phrases in sequential order and keeping the phrases as brief as possible. Second, during implementation nurses took so much time to draft their open-ended statements that the sessions went over their scheduled time. When necessary, the VA removed the open-ended questions to shorten the time.

The SBAR assessment simulation was implemented in a blended approach to support application level learning. Once nurses completed the online activity, they then participated in a live role play simulation with a standardized patient. This strategy of beginning with an online experience, prior to participating in a live simulation, can be an effective way of scaffolding learning and reducing stress. Live simulations can be more stressful since they are observed and are often videotaped. However, the approach of having learners begin with the online activity, allows them to explore the concept in a safe, non-threatening environment and to receive consistent coaching prior to applying the model real-time, with a live actor.

The Kaiser and VA simulations cover very different skill sets and content areas and use unique branching to empower both learners and organizations to discover targeted insights. Yet, both create rich narrative VP experiences that emotionally engage learners and promote the development of new illness scripts.

The Kaiser simulation uses an alternate branching technique to provide learner control over the flow of information and decision-making. The consequence effect and feedback for this simulation are extensive and personalized to each learner’s decisions. The simulation uses simple media such as custom developed photos, audio clips and videotapes, that when paired with well-crafted character development, carry the story.

The VA simulation uses branching techniques to enable learners to determine the pathway of the video-based story based upon their implementation of the SBAR communication model. Rather than receiving feedback solely from a mentor, they see and hear the physician’s response to their communication first—much as they would in a real-world setting. The resulting flow guides learners from attempting the skill without prompting, to applying it with prompting, to seeing the effect of their first attempt. Then learners observe the consequences of their communication, reflect on their performance, and finally review an exemplar role play video. The design of the VA simulation presents an authentic portrayal of the health care setting, freedom over simulation flow and presents opportunities to make decisions, observe consequences, and receive feedback.

**Designing for Data Analysis and Measurement**

The branching designs and VP simulation examples depict the types of performance data these simulations can collect and explain how they can be used to facilitate insights for both learners and organizations. However, there are many other types of data that can be collected. For example, VP simulations can
record demographic, participation, engagement, and satisfaction data which can be used to analyze the performance data in more detail, and to identify opportunities to improve the simulation. Data dashboards can provide drill down data so that organizations can compare decisions made by demographics, such as years in practice, geographic location, etc. Comparisons can also be made between diagnostic accuracy, treatment efficacy, confidence levels, and resource utilizations. Additionally, qualitative data can be captured to measure open-ended responses. Learners can receive scorecards summarizing their performances, and personalized coaching reports comparing their performance to that of their peers.

While there are many opportunities for data collection, designers need to create an engaging experience that will include the necessary decision points to ensure the simulation captures the desired information. Without the appropriate design, the information will not be captured. Consequently, planning for assessment and metrics must be considered early on in the analysis phase and must be consistently evaluated throughout successive iterations of design and development.

Conclusion

While VP simulations have great potential, their development has unique requirements and there has been little guidance about effective design strategies. By integrating the art of storytelling with the science of instructional design during the creation of VP simulations, clinical stories can be built that strategically align learning objectives with decision points, consequences, and coaching opportunities. Assessment and metrics must also be planned throughout the iterative design process to ensure that both learners and the organizations implementing the simulation are guided towards the targeted insights. In addition, instructional designers in the healthcare context must collaborate effectively with a variety of subject matter experts and team members as they craft an emotionally engaging, clinically relevant experience.

As David Rock (2009) so aptly stated, real change occurs when people discover things they have not experienced before. Within the healthcare setting particularly, it is not always feasible to provide real world experiences for the large number of patient journeys needed to build the clinician’s mental library of illness scripts. Nor is it always necessary or advisable. VP simulations can facilitate the process of discovering insights, so that learners are better able to remember, retrieve, and apply the targeted skills in a real-world context. When we craft an engaging story that enables learners to make their own decisions, to experience the consequences of their actions, and then, with the help of a mentor, to reflect upon the outcomes, we set the stage for true change.

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Strategic Instructional Design of Interprofessional Education in Health Professions Curricula

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Abstract: Interprofessional education (IPE) brings together health care practitioners from different specialty areas to equip them with skills for cross-discipline collaborations. Viewed as integral to comprehensive patient care, interprofessional collaboration is receiving increased emphasis across health professions programs and has generated the need for strategic instructional design that integrates evaluation measures and matches IPE competencies with effective instructional approaches. The Content-Evaluation-Method (CEM) instructional design strategy is presented as a framework, along with examples, to guide the development of IPE curricula that incorporates and aligns key components of IPE content, evaluation considerations, and pedagogical methods.

Keywords: instructional design, interprofessional education, health professions students, health professions practitioners, health professions education, team-based learning, role-playing, curriculum development, IPEC competencies, accreditation standards, evaluation, health care
as is evidenced by a tripling in the number of medical schools over the past 10 years that are now incorporating IPE into their curricula (Association of American Medical Colleges, 2019).

There are two major shifts that have fueled greater emphasis on IPE in recent years. First, effective collaboration among health professionals has been shown to enhance the quality of patient care, lower health care costs, decrease patient length of stay in a health care facility, and decrease medical errors (Knebel & Greiner, 2003). Second, the incorporation of IPE into curricula and training for health professions is increasingly gaining traction with accreditation agencies. In 2019, 24 accreditation agencies joined forces with the National Center for Interprofessional Practice and Education to produce Guidance on Developing Quality Interprofessional Education for the Health Professions (Health Professions Accreditors Collaborative & National Center for Interprofessional Practice and Education, 2019). Additionally, accreditors of most health professions (e.g., pharmacy, allopathic medicine, osteopathic medicine, physician assistant, physical therapy, audiology, speech language pathology) have included IPE in recent revisions of their accreditation standards to ensure that graduates have the competencies needed to function as members of interprofessional teams (Accreditation Commission for Audiology Education, 2016; Accreditation Council for Pharmacy Education, 2015; Accreditation Review Commission on Education for the Physician Assistant, Inc., 2018; Commission on Accreditation of Physical Therapy Education, 2017; Commission on Osteopathic College Accreditation, 2016; Council on Academic Accreditation in Audiology and Speech-Language Pathology, 2017; Liaison Committee on Medical Education, 2019).

To accommodate major shifts that have led to increased attention on IPE, great strides are being made in IPE learning experiences so that they effectively equip health professions students and practitioners to be able to collaborate with each other to achieve thorough, 360° patient care. In 2009, six national education associations for schools of various health professions (including the American Association of Colleges of Nursing, American Association of Colleges of Osteopathic Medicine, American Association of Colleges of Pharmacy, American Dental Education Association, Association of American Medical Colleges, and the Association of Schools of Public Health) formed the Interprofessional Education Collaborative (IPEC) to advance interprofessional learning experiences that are focused on preparing future health care practitioners for team-based care of patients and ultimately improved population health outcomes (IPEC, 2011).

The IPEC (2011, 2016) created core competencies for interprofessional collaborative practice to guide curriculum development across health professions schools with the goal of increasing quality and safety in health care. There are four IPEC IPE core competency domains - values/ethics for interprofessional practice, roles/responsibilities, interprofessional communication, and teams and teamwork, and each of these domain areas contain specified sub-competencies (IPEC, 2016). Competency in values/ethics for interprofessional practice requires health care professionals to have a patient-centered focus within a community/population orientation. This focus is grounded within a shared purpose among the interdisciplinary team to support the common good in health care and to advance a “shared commitment to creating safer, more efficient, and more effective systems of care” (IPEC, 2011, p. 17). Health care professionals must also be competent in understanding how roles/responsibilities of other health care professionals complement each other in a community/population-oriented health care environment that is patient-centered. Role clarity can facilitate coordination of patient care and help to optimize the scope of practice for each member of the patient care team. Health care professionals must be competent in interprofessional communication to communicate responsively, collaboratively, and respectively with other health professionals in a health care team. Communication skills can relate to engaging effectively in verbal dialogue and discussion as well as enacting active listening and supportive nonverbal communicative gestures and expressions. Finally, they need to be competent in teams and teamwork so they can “[cooperate] in the patient-centered delivery of care; [coordinate] one’s care with other health professionals so that gaps, redundancies, and errors are avoided; and [collaborate] with others through shared problem-solving and shared decision making” (IPEC, 2011, p. 24).
The guidance offered by the Health Professions Accreditors Collaborative and the National Center for Interprofessional Practice and Education targets the development and implementation of the core interprofessional competencies. However, medical schools are experiencing numerous challenges to implementing IPE, including “curriculum, leadership, resources, stereotypes, students’ diversity, IPE concept, teaching, enthusiasm, professional jargons, and accreditation” (Sunguya, Hinthong, Jimba, & Yasuoka, 2014, p. 1). For example, finding the time and opportunity to schedule the implementation of IPE is a common challenge, but one solution has been to integrate IPE into the existing core curriculum instead of adding it as a separate course or program (Sunguya et al., 2014). Additionally, leadership challenges have included poor planning, lack of coordination and organization, and lack of interest or support by administrators (Sunguya et al., 2014). Thus, even though accreditation guidelines may now include IPE expectations, integrating IPE into curricula that has been historically separated due to the specialization of health care delivery has been met with resistance.

Some of the ways institutions are working to overcome these challenges include “commitment from departments and colleges, diverse calendar agreements, curricular mapping, mentor and faculty training, a sense of community, adequate physical space, technology, and community relationships” (Bridges, Davidson, Odegard, Maki, & Tomkowiak, 2011, p. 1). To address challenges fully, different facets of IPE instructional experiences need to be considered, including “the need for administrative support, interprofessional programmatic infrastructure, committed faculty, and the recognition of student participation as key components to success for anyone developing an IPE centered program” (ibid, p. 1).

Nonetheless, there are systemic drivers for incorporating IPE into health professions curricula, and many health professions schools are working to make changes to their curricula to achieve IPEC competencies. Though implementation of IPE seems to be widespread (Copley et al., 2007; Djukic, Fulmer, Adams, Lee, & Triola, 2012; MacDonnell, Rege, Mist, Dollase, & George, 2012; Marcel, 2005), “vast differences in IPE practices exist in health professions education” (West et al., 2016, p. 45). Instructional designers are challenged with not only incorporating IPE content into the curricula but also knowing which instructional approaches are effective for teaching IPE content and how to align IPE content, methods, and evaluation. Therefore, an instructional design strategy specifically crafted for IPE can support instructional design professionals working in health professions schools to be able to more consistently and comprehensively develop IPE curricula. This paper addresses this need by offering guidance for incorporating IPE into health professions curricula through an instructional design strategy that includes planning, implementing, and evaluating core components of IPE learning.

**Developing an Instructional Design Strategy for IPE**

The term *instructional design strategy* is used in this paper to refer to a plan for aligning the key components of IPE content, evaluation considerations, and pedagogical methods (Figure 1). Henderson, O’Keefe, and Alexander (2010) suggest that an instructional design strategy for IPE should promote “effective communication, collaboration, and teamwork within health care settings to improve patient care and student learning outcomes” (p. 224). Delivery methods to accomplish this may vary, as do evaluation approaches. For example, at least 42 tools have been developed to evaluate IPE learning (Shrader, Farland, Danielson, Sicat, & Umland, 2017).

The Content-Evaluation-Method (CEM) instructional design strategy (see Figure 1) proposed in this paper aligns content that is first driven by learning objectives (based on IPEC sub-competencies), the selection of valid and reliable ways for evaluating the sub-competencies, and the utility of theoretically-based educational methods for teaching the sub-competencies. Each of the components of this strategy will be described briefly.
Content

The core of the CEM instructional design strategy for the development of IPE curricula is the content that is based on the 39 IPEC sub-competencies within the four IPE domains of values/ethics for interprofessional practice, roles/responsibilities, interprofessional communication, and teams and teamwork (IPEC, 2016). Designers first select the targeted IPEC sub-competencies and then draft learning objectives to align with those sub-competencies (Gunaldo, Brisolara, Davis, & Moore, 2017). The learning activities are then developed in alignment with the IPEC-grounded learning objectives to support learner development of knowledge and skills identified in the IPEC sub-competencies. Designers can map IPEC sub-competencies to learning objectives and learning activities and build in several IPE options to ensure competency coverage (West et al., 2015). Comprehensive IPE programs would ultimately address all IPEC sub-competencies at some point in the completed program curricula.

The iCATS (Interprofessional Collaboration and Team Skills) program is an example of a successful IPE curriculum that mapped learning objectives and learning activities to IPEC sub-competencies (Woltenberg & Taylor, 2018). The program was developed at the University of Kentucky and serves as the core interprofessional curriculum for seven of their health professional programs. iCATS addresses various IPEC sub-competencies through experiential learning approaches. One session, for instance, includes a simulation activity in which learners enact the PEEER (Plain Language, Engagement, Empathy, Empowerment, Respect) model (see Conigliaro, Kuperstein, Dupuis, Welsh, & Taylor, 2013). The activity is designed to address development of sub-competencies in the IPEC domains of teams and teamwork and interprofessional communication.
Evaluation

Evaluation is a recommended component of IPE curricular design that can offer added value when developed from the outset and used to guide decision-making throughout implementation (Anderson, 2016). It should be noted that there is currently not a broadly accepted, valid and reliable way to measure the effectiveness of IPE on patient outcomes (Dow, DiazGranados, Mazmanian, & Retchin, 2014; Institute of Medicine, 2015). Further, while connecting long-term outcomes to IPE learning experiences is ideal, there are methodological challenges to long-term observation of learners, such as changes in learners’ areas of clinical practice after the IPE training. Thus, in the area of IPE curriculum development, there tends to be a reliance on short-term measurements of effectiveness and the drawing from theoretical grounding of instructional design practices used for the development of curricula in other content areas.

Many IPE programs that report on evaluation aspects incorporate Kirkpatrick’s training evaluation model (e.g., Reeves, Boet, Zierler, & Kitto, 2015). Use of this model could be due in part to its intuitive application in the categorization of IPE outcomes (Committee on Measuring the Impact of Interprofessional Education on Collaborative Practice and Patient Outcomes; Board on Global Health; Institute of Medicine, 2015). Kirkpatrick viewed the evaluation of educational outcomes at four levels—reaction, learning, behavior, and impact (Kirkpatrick, 1979; Kirkpatrick & Kirkpatrick, 2006, 2007). Related to the evaluation of IPE, reaction level measures may include learner satisfaction with and perceptions of the interprofessional nature of an educational program. Learning level measures determine the extent of learners’ understanding related to learning objectives, their attitudes regarding the enactment of team approaches, and their developed interprofessional skills. Behavior level measures determine the extent that learners apply what they have learned in an IPE learning experience to their practice in a health professions setting. Impact level measures are the long-term considerations of changes to organizational practice and patient, family, and community outcomes that can be directly connected back to an IPE program. Deciding what to evaluate and at what levels involves identifying stakeholder priorities regarding evaluation data and considering the availability of resources (including people, time, and budget) that would be needed to complete the evaluation (Kirkpatrick & Kirkpatrick, 2007).

The National Center for Interprofessional Practice and Education (2018) lists 50 measurement tools that can be used to evaluate IPE at one or more of the Kirkpatrick evaluation levels. These tools can be used to support evaluation of individual, team, and organization-wide IPE programs. IPE evaluation instruments are also available from the Canadian Interprofessional Health Collaborative (2012) and the Harvard Business School (Valentine, Nembhard, & Edmondson, 2011). Most IPE evaluation instruments assess outcomes as attitudes (primarily within the Kirkpatrick’s evaluation level 2 [learning]), though several instruments have been developed for assessing outcomes at more than one outcome level (typically levels 1 [reaction] and 2 [learning]) (Blue, Chesluk, Conforti, & Holmboe, 2015).

Method

Tennyson (2010) speaks of the importance of grounding design in related theory when he argues for the “explicit placement of educational foundations into the methodology of instructional systems design” (p. 13). The CEM instructional design strategy values the utility of learning and instructional theory as foundational to IPE learning experiences, and it guides designers to consider relevant theoretical frameworks as they develop IPE curricula. By situating the design of IPE learning activities within related theoretical frameworks, designers will be able to articulate their rationale for selected instructional approaches in the IPE curricula and use the selected theories to scaffold their application of associated teaching methods (Hean, Craddock, Hammick, & Hammick, 2012; Sargeant, 2009). IPE pedagogical approaches that have been found to be effective in terms of student learning outcomes include those that “maximize opportunities for interaction” (Reeves, Goldman, & Oandsan, 2007, p. 232) and that “engage students in teams and are conducive to role exploration, application of various communication techniques and ‘hands-on’ team development” (West et al., 2016, p. 44).

Though there are numerous relevant theoretical frameworks, social learning theory and active learning are particularly key for IPE. Social learning theory posits that people
learn from each other through observation, imitation, and modeling (Bandura, 1977). Cognitive components of self-regulation, attention, and control are considered important elements of the process as learners acquire target knowledge and skills within a health care environment (Braungart, Braungart, & Gramet, 2020). For example, in IPE, social learning grounds the instructional approach of role modeling in which more experienced health professionals could demonstrate for learners how they communicate their roles and responsibilities to other members of a patient care team (roles/responsibilities sub-competency 1). Active learning is a pedagogical approach in which students actively construct their knowledge (Carr, Palmer, & Hagel, 2015; West et al., 2016). Active learning is based on constructivist learning theory, in which individuals actively construct knowledge by connecting new knowledge with existing knowledge (Bransford, Brown, & Cocking, 1999). Contrasted with behaviorism and associated direct instruction approaches (such as lecture) in which learners are viewed as receivers of information, active learning promotes learner involvement through discussion, writing, application of higher-order thinking skills such as synthesis, problem-solving, and interactions with others. An active learning-grounded IPE activity could involve a role-play discussion in which learners take on specific roles that reflect different values and goals and enact how they would navigate the contrasting views within their team to reach a consensus regarding a patient care decision (teams & teamwork sub-competency 6).

**Applying the CEM Instructional Design Strategy**

The intention of the CEM instructional design strategy is that it can be used to develop any format of IPE, ranging from a single module that covers only one IPEC sub-competency to a full-day workshop that covers several IPEC sub-competencies to an entire curriculum that spans all 39 IPEC sub-competencies. As a starting point, designers are advised to first select the IPEC sub-competencies that will be targeted in the proposed instruction (i.e., the content). Then, designers work through the evaluation and method components in order to ensure development of a comprehensive IPE curriculum.

Two instructional methods that present considerable promise for interprofessional learning are team-based learning ([TBL] Chan et al., 2017; Jorm et al., 2016; Lochner et al., 2018; Nisbet, Gordon, Jorm, & Chen, 2016; Quesnelle, Bright, & Salvati, 2018; Sisk, 2011) and role-playing (Adrian, Zeszotarski, & Ma, 2015; Awad et al., 2005; Christopher et al., 2019; Sargeant, MacLeod, & Murray, 2011; Shortridge et al., 2019; Villadsen, Allain, Bell, & Hingley-Jones, 2012). Examples from the literature involving TBL and role-playing in IPE initiatives will be presented through the lens of the CEM instructional design strategy to demonstrate how designers can align content, evaluation, and methods in IPE curriculum (see Appendix A CEM alignment instructional design strategy for developing IPE).

The reader should note that some CEM components are identified specifically by the authors of the IPE examples, and other components are inferred implicitly for demonstration purposes.

The teamwork focus of TBL corresponds to the collaborative nature of IPE, making it a suitable pedagogical choice for many IPE initiatives (Michaelson, Knight, & Fink, 2002). TBL structures learning activities within small groups of 5-7 learners (Sisk, 2011; Team-Based Learning Collaborative, n.d.), requires interactions among learners, involves scenario-based learning, and incorporates adult learning principles (Chan et al., 2017). TBL has been shown to improve content knowledge (Quesnelle et al., 2018), perceptions of interprofessional collaboration (Lochner et al., 2018; Quesnelle et al., 2018), mutual understandings of expertise of health care professionals in other disciplines (MacDonnell et al., 2012), teamwork effectiveness (MacDonnell et al., 2012), and readiness for interprofessional learning (Chan et al., 2017; Lochner et al., 2018). The building of realistic case scenarios that engage all of the participating health care professions is a critical element of TBL application in IPE (Jorm et al., 2016; Lochner et al., 2018; Nisbet, Gordon, Jorm, & Chen, 2016).

One example of an IPE initiative using TBL is Lochner and colleagues’ (2018) three-day InterProfessional Education in Patient Safety (iPEPS) course designed for health professions students from five different health
professions programs (nursing, dietetics and nutrition, occupational therapy, radiology techniques, and laboratory techniques). Learning objectives include learners’ reflections on their attitudes toward critical incidents and how these are managed interprofessionally, recognition of the varied perspectives and roles within an interprofessional team, and completion of a critical incident report form with an interprofessional team (see Appendix A CEM alignment instructional design strategy for developing IPE). In reviewing Lochner et al. (2018), evaluation at three Kirkpatrick levels are apparent – student reaction to TBL, attitudes toward IPE, and behavior in terms of individual performance and team performance. Assessment tools include Team-Based Learning Student Assessment Instrument (TBL-SAI), Interprofessional Questionnaire (UWE-IP-D), Individual Readiness Assurance Test (IRAT), and Group Readiness Assurance Test (GRAT).

The iCATS program mentioned earlier is another example of an IPE initiative that facilitates IPE learning experiences using a TBL instructional approach (Woltenberg & Taylor, 2018). iCATS learning objectives connect to several IPEC sub-competencies from each of the IPEC domains. The program is designed as an embedded learning experience within an existing required course that is part of seven different health professions programs at the university. Appendix A identifies several of the IPEC sub-competencies and their corresponding learning objectives and evaluation measures from the iCATS curriculum.

Educators have also experienced success in using role-playing as a way to teach IPE (e.g., Awad et al., 2005; Villadsen et al., 2012). Role-playing has been used in interprofessional workshops and communications skills courses to provide health professions students of different disciplines opportunities to practice communication skills. Results from recent studies on IPE initiatives involving role-play include the cultivation of more positive views towards IPE (Villadsen et al., 2012), communications skills improvements (Awad et al., 2005; Sargeant et al., 2011), enhanced appreciation and knowledge of effective oral communication (Adrian, Žeszotarski, & Ma, 2015), improved outlooks on teamwork and roles within the health care system (Christopher et al., 2019), and positive responses from patients (Sargeant et al., 2011).

Online modules and handouts can support role-play activities by providing learners with necessary foundational knowledge of IPE that they can use to more fully engage in the immersive learning experience (McKee, D’Eon, & Trinder, 2013).

Christopher and colleagues (2019) provide an example of an IPE initiative for pharmacy and physician assistant students that uses role-play. The learners were first provided with handouts to aid in their understanding of each other’s roles, and then the teaching faculty explained the role-play case scenario. The team-based role-playing case provided each student with opportunities to practice his/her own discipline and observe the other discipline as s/he played the part of a mock patient. Two of the four learning objectives focused on IPEC sub-competencies in the domains of roles/responsibilities and teams and teamwork. The Readiness for Interprofessional Learning Scale (RIPLS) survey was used to evaluate attitudes about teamwork, collaboration, and IPE (an evaluation at Kirkpatrick’s level 2 [learning]).

Conclusion

The examples presented in this article illustrate how the CEM instructional design strategy frames alignment among content, evaluation, and methods in recent IPE initiatives. Instructional design strategies like the CEM are useful for structuring the design of IPE curricula so that they provide students with meaningful experiences that enhance their understanding of the roles and values of health care professionals in other specialty areas and help them to collaborate with colleagues from these areas more effectively. Developing curricula that support engagement with and mastery of the IPEC core competency domains of values/ethics for interprofessional practice, roles/responsibilities, interprofessional communication, and teams and teamwork is an important step in equipping health care practitioners to reduce health care delivery fragmentation and provide more comprehensive 360° patient care. It is recommended that instructional designers use CEM to guide development of robust IPE learning experiences so that learning objectives, evaluation components, and pedagogy are planned strategically and comprehensively to address specified IPEC sub-competencies.
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### Appendix A
CEM instructional design strategy applied to three IPE-initiative examples.

<table>
<thead>
<tr>
<th>IPE-initiative example</th>
<th>IPEC sub-competency (IPEC, 2016)</th>
<th>Content</th>
<th>Evaluation</th>
<th>Method</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lochner et al. (2018)</td>
<td>Values/Ethics sub-competency #4: Respect the unique cultures, values, roles/responsibilities, and expertise of other health professions.</td>
<td>“Reflect on their personal attitude towards critical incidents and how these are managed within an interprofessional team.” (p. 4)</td>
<td>Level 1 (reaction to TBL)</td>
<td>Team-Based Learning Student Assessment Instrument (TBL-SAI)</td>
<td>Social constructivism</td>
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<td></td>
<td>Roles/Responsibilities sub-competency #2: Recognize one’s limitations in skills, knowledge, and abilities.</td>
<td>“Recognize the perspectives and roles within an interprofessional team.” (p. 4)</td>
<td>Level 2 (attitudes toward IPE)</td>
<td>Interprofessional Questionnaire (UWE-IP-D)</td>
<td>Team-Based Learning Student Assessment Instrument (TBL-SAI)</td>
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<td></td>
<td>Team and Teamwork sub-competency #10: Use available evidence to inform effective teamwork and team-based practices.</td>
<td>“Decide which critical incidents need to be reported and justify the decision within an interprofessional team.” (p. 4)</td>
<td>Level 3 (behavior in terms of individual performance)</td>
<td>Individual Readiness Assurance Test (IRAT)</td>
<td>Team-Based Learning Student Assessment Instrument (TBL-SAI)</td>
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<td>Level 3 (behavior in terms of team performance)</td>
<td>Group Readiness Assurance Test (GRAT)</td>
<td>Team-Based Learning Student Assessment Instrument (TBL-SAI)</td>
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<tr>
<td>Woltenberg &amp; Taylor (2018)</td>
<td>Values/Ethics sub-competency #4:</td>
<td>“Students will be able to describe in general terms the programs of study of the various health professions programs participating in iCATS.” (p. 664)</td>
<td>Level 1 (degree to which they agree that the iCATS experience provided a foundational understanding of IPE and collaboration in health care)</td>
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<td>Respect the unique cultures, values, roles/responsibilities, and expertise of other health professions and the impact these factors can have on health outcomes.</td>
<td>“Students will be able to describe in general terms the scopes of practice of professionals in the various health professions programs participating in iCATS.” (p. 664)</td>
<td>Level 2 (knowledge of other health professions’ educational requirements and scope of practice)</td>
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<td></td>
<td>Roles/Responsibilities sub-competency #4:</td>
<td>Explain the roles and responsibilities of other care providers and how the team works together to provide care, promote health, and prevent disease.</td>
<td>Interprofessional Collaborative Competency Attainment Scale (ICCAS)</td>
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<td></td>
<td>Explain the roles and responsibilities of other care providers and how the team works together to provide care.</td>
<td>“Recognize the roles, responsibilities, and importance of various health care professionals in the patient-centered health care team.” (p. 1)</td>
<td>Active learning Social learning</td>
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<td></td>
<td>“Demonstrate teamwork, respect, integrity, and professionalism during interprofessional collaboration.” (p. 1)</td>
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<td></td>
<td>Level 2 (Attitudes about teamwork, collaboration, and IPE)</td>
<td>Readiness for Interprofessional Learning Scale (RIPLS) survey</td>
<td>Experiential learning</td>
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<td></td>
<td>Christopher et al. (2019)</td>
<td>Interprofessional team role-play case</td>
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Developing an Education Concentration to Enhance a PharmD Program

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Abstract: The Doctor of Pharmacy (PharmD) degree is a professional program that prepares students to become licensed pharmacists. PharmD programs differentiate themselves through a variety of ways, one being to offer students the opportunity for secondary specialization or certification in the curriculum through concurrent degrees, certificate programs, or concentrations. Developing the curriculum of such a program, effectively utilizing resources, and attaining sustainability can be a challenge. This paper details the collaboration of instructional designers, faculty, and students during the analysis, design, implementation, evaluation, and improvement of a newly created education concentration program.

Keywords: program concentration, collaborative design, instructional design, pharmacy education

Collaborative Practice: Developing an Education Concentration to Enhance a PharmD Program
The Doctor of Pharmacy (PharmD) degree is the curricular pathway that prepares students for professional licensure. For licensure purposes PharmD programs must be accredited by the Accreditation Council for Pharmacy Education (ACPE). As per ACPE Standards, PharmD curriculums must be “a minimum of four academic years of full-time study, or the equivalent” (Accreditation Council for Pharmacy Education, 2016, p. 6). To fulfill this requirement, our program consists of three years of didactic education, followed by one year of experiential rotations. The didactic curriculum includes lecture-based theory, basic application, and simulation; whereas practice-based application is obtained during experiential rotations. The ACPE Standards include education outcomes centered around the four sciences: biomedical; pharmaceutical; social/behavioral/administrative; and clinical. The educational outcomes also include soft-skill development that are essential for practice, personal and professional development (Accreditation Council for Pharmacy Education, 2016).

Pharmacy programs seek to differentiate themselves through a variety of strategies, a common one is offering opportunities for secondary specialization or certification. Some programs allow students to obtain concurrent...
degrees, such as a Master’s in Business Administration or Public Health; however, these programs require additional courses and tuition. Another option is to offer concentrations, which are the graduate equivalent to undergraduate minors, but have the advantage of aligning with program curricular requirements. Across the country the availability of concurrent degrees and concentrations vary widely.

Providing pharmacy students with the opportunity to complete a second degree or specialize in a secondary area of focus via a concentration may entice student applicants; however, developing the curriculum, effectively utilizing resources, and attaining sustainability can be a challenge. This paper describes the collaborative process between instructional designers and faculty during the analysis, design, implementation, evaluation, and improvement of a teaching concentration associated with a PharmD program.

Analysis

The [university] College of Pharmacy (COP) matriculated its inaugural class in 2011, with the first class graduating in 2015. Upon successful implementation of the curriculum and attainment of accreditation, the Office of Academic Affairs (OAA) was charged with identifying value-added educational opportunities that afforded customization based on student career aspirations. The OAA investigated concurrent degrees, certificates, and concentrations. To establish baseline interest and need for these programs a survey was administered in February 2016 to all enrolled pharmacy students and pre-pharmacy applicants who had applied and been accepted to matriculate into the program as part of the next fall cohort.

Survey questions included demographic items pertaining to student status and highest degree attained. The survey assessed interest for six specified concentrations and included the options “other” and “not interested.” The six concentration foci were based upon preliminary qualitative focus groups and alignment with the COP pillars (Geriatrics, Personalized Medicine, Informatics, and Leadership). Students were asked to select and thereafter rank concentrations based on interest.

A total of 230 students answered the survey. Responses were evenly split between currently enrolled students (47.8%) and pre-pharmacy students (52.2%). Table 1 includes a description of the student demographics. The distribution of respondents was deemed appropriate for evaluation purposes because currently enrolled students were essential for concentration creation; whereas program sustainability would be predicted by pre-pharmacy response trends.

Table 1

Demographic Characteristics of Concentration Interest Survey Respondents

<table>
<thead>
<tr>
<th>Student Status</th>
<th>Respondent n (%)</th>
<th>Highest Degree Earned n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Degree</td>
<td>Associates</td>
</tr>
<tr>
<td>Any</td>
<td>230</td>
<td>32 (13.9)</td>
</tr>
<tr>
<td>Pre-Pharmacy</td>
<td>120 (52.2)</td>
<td>25 (20.8)</td>
</tr>
<tr>
<td>Enrolleda</td>
<td>110 (47.8)</td>
<td>7 (6.4)</td>
</tr>
</tbody>
</table>

*Enrolled pertains to all students who were currently enrolled in the PharmD program and actively taking classes. Data represents student responses from all for years of the program.
Table 2 includes an overview of student concentration foci preference. Academia was identified as the third highest concentration foci of interest (35%); however, was ranked second in terms of preference for all respondents (44%). The COP decided to pursue the Pharmacy and Health Education (RXHE) concentration as its first offering secondary to survey findings, potential instructor availability, and existing available course offering. At the time of development, the totality of anticipated faculty and staff had been hired, which included sufficient talent required for the concentration. Additionally, the COP tuition is bundled, thus is not dependent on credit hours. It appeared to be the concentration with the greatest potential for program sustainability.

**Design**

Initial design of the concentration included input from a team comprised of faculty, an instructional designer, Student Affairs administrative staff, and the Associate Dean for Academic Affairs. Students serving as supplemental instructors for the COP who had expressed an interest in completing such a concentration provided input via focus groups. Before starting to design the new concentration, the team determined that all educational innovations must support the mission and vision of the University and the College, as well as their strategic plans. From these guidance documents, the team focused the design of the concentration first and foremost on student success as educators in various pharmacy settings and then benefits to the college via interprofessional and scholarly collaborations that occur due to the concentration. Finally, the College required sustainability of long-term implementation.

The first design step was to define concentration specific student learning outcomes. In the survey used in the needs analysis, the option presented to students was focused on academia; to attract the largest cohort of students possible and to align with the required educational skills of a pharmacist, the team decided to create broader programmatic student learning outcomes to prepare students to be health educators. Unlike other academia-

<table>
<thead>
<tr>
<th>Concentration Focus</th>
<th>Total Students Interested(^a)</th>
<th>Ranked Topic as First Preference(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Respondents (n = 210)</td>
<td>Pre-Pharmacy (n = 110)</td>
</tr>
<tr>
<td>Academia</td>
<td>81</td>
<td>46</td>
</tr>
<tr>
<td>Geriatrics</td>
<td>55</td>
<td>26</td>
</tr>
<tr>
<td>Pharmacogenomics</td>
<td>111</td>
<td>67</td>
</tr>
<tr>
<td>Leadership</td>
<td>100</td>
<td>49</td>
</tr>
<tr>
<td>Informatics</td>
<td>68</td>
<td>27</td>
</tr>
<tr>
<td>MS Pharmacy</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>Other(^c)</td>
<td>85</td>
<td>38</td>
</tr>
</tbody>
</table>

*Note.* Students who responded they did not have interest in completing a concentration were not included in this data.

\(^a\) Students could select more than one concentration focus of interest.

\(^b\) Students ranked each concentration focus in order of preference. Only one focus could be selected as the top choice. This was not a required question on the survey, but there was a 96% and 94% response rate for those interested in completing a concentration.

\(^c\) Other for all respondents included over 20 unique focus areas.
focused concentrations, the primary outcome of the RXHE concentration is to prepare students for the educational responsibilities of a pharmacist. Competency in education is essential for pharmacists because almost every facet of pharmacy practice in contemporary healthcare requires some degree of understanding teaching and learning theory. Examples of educational pharmacist responsibilities include medication counseling to patients and family members, providing informal or formal presentations to other healthcare providers, serving as a preceptor for students or residents, and population health education. The title, Pharmacy and Health Education Concentration, conveys the goal of preparing pharmacy students to be healthcare educators regardless of setting.

The second design step was to establish the program of study which necessitated a review of University and College policy. University standards require a distinct number of credit hours for required and elective courses. Additionally, College and financial aid policies were investigated to identify the total number of electives and semester credit hours (SCH) students could take, and how this would affect their tuition. Our professional program tuition is set up as a flat-fee. Therefore, if students take more credit hours in a semester than required by the PharmD program, their tuition does not increase. To reduce the workload burden of creating new courses for the concentration and the credit hour burden on student study time, the COP team reviewed existing pharmacy courses which included student learning outcomes that sufficed either core or elective components of the concentration. Thereafter determinations were made regarding the creation of new, necessary courses.

The concentration required creation of two didactic courses to achieve the programmatic student learning outcomes. The first course, HSC6261 Teaching Essentials, provides the foundational premise of teaching and learning principles and a small group environment to practice application of skills. This course is organized around the book “7 Research-based Principles for Smart Teaching” (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010) using a collaborative learning format. Each student facilitates a fifty-minute class based upon an assigned book chapter. Students learn how to give live positive and constructive formative feedback, utilize this feedback in self-reflective processes, and learn from each other's experimentation with different teaching techniques in a small group setting.

The second core course, HSC6261C Teaching Essentials Lab, builds upon fundamentals learned in the Teaching Essentials course, and provides opportunity for students to further develop their teaching skills through development of workshops. Students are paired with a chosen faculty mentor who provides guidance on the development of lesson plans, classroom management, and alignment of content. Students select the topics and audience for their workshops, design the learning experience including an assessment, and coordinate the delivery. They are required to provide a minimum of four hours of instruction and at least two workshops. This intentional design is to promote incorporation of formative feedback from the first session and to encourage opportunities for trying new teaching techniques.

The final required course in the concentration is an Advanced Pharmacy Practice Experience (APPE) focused in academia during the students’ fourth year. This course was already being offered by a faculty member and did not require extensive development or redesign.

Due to unforeseen challenges, the initial plan for the program of study was modified in respect to the elective offerings to satisfy the requirements of the concentration. For example, the original design sought out to create a new academia elective designed and developed by our Interprofessional Education Coordinator and Dean of Student Affairs; however, due to changes in these positions and workload from the time of design to development, the concentration decided to identify already created elective courses whose objectives aligned with the RXHE concentration goals as viable courses instead. If an elective course had activities that aligned with learning outcomes of the concentration but did not correlate to a specific objective listed in the syllabus, a substantive change was made to add the objective to the course. The original design sought at least two electives so students could
customize the concentration focus. Table 3 outlines the final program of study and indicates which courses were created specifically for this program.

To personalize their concentration experience, students may select one elective course with a minimum of two semester credit hours. Course foci include a clinical specialty focus such as critical care or oncology, an academic focus such as course design or program development, and research-related options in the scholarship of teaching and learning. The initial concentration electives were chosen from previously existing electives, some of which required substantive changes at the University level to ensure at least one course outcome aligned with the concentration's programmatic outcomes. With the student-centered focus of the program, some faculty elected to offer Directed Independent Studies (DIS) to provide students with opportunities in the scholarship of teaching and learning (SOTL) tailored to their interests while also benefiting the college. The instructional designers contributed their educational expertise to these endeavors.

The creation of student enrollment processes was the final design step. The decision of when students could enroll in the concentration and courses revolved around three criteria: (a) Student success: the RXHE concentration requires additional credit hours on top of the credit hour requirement for the PharmD program, (b) Course design: components of the first core course, Teaching Essentials, were intertwined with the supplemental instruction program, and (c) Alignment with graduation: students must be able to complete the required coursework prior to graduating the PharmD program. Therefore, the program allowed students to enroll in the concentration and courses in their second and third year of the program, as long as they met minimum GPA requirements and had letters of support that at-

Table 3

Pharmacy and Health Education (RXHE) Concentration Program Overview

<table>
<thead>
<tr>
<th>Student Learning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articulate the role of life-long learning in the Pharmacy Profession and ways to utilize self-reflection to identify areas of need.</td>
</tr>
<tr>
<td>Describe career paths in health education and the roles and responsibilities of health educators.</td>
</tr>
<tr>
<td>Employ effective teaching and assessment methods to provide appropriate education to various populations including peers, other health professionals, and the general public.</td>
</tr>
<tr>
<td>Create effective learning environments, teaching tools and assessments based-upon evidence-based learning theory and cognitive practice.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Courses</strong> – 9 Semester Credit Hours (SCH)</td>
</tr>
<tr>
<td>HSC 6261 Teaching Essentials</td>
</tr>
<tr>
<td>HSC 6261L Teaching Essentials Lab</td>
</tr>
<tr>
<td>PHA 7684 Elective Pharmacy Practice Experience: Academia</td>
</tr>
<tr>
<td><strong>Elective Courses</strong> – minimum 2 SCH (Select one of the following)</td>
</tr>
<tr>
<td>PHA 6877C Critical Care Pharmacotherapy</td>
</tr>
<tr>
<td>PHA 6780C Oncology Pharmacy Practice</td>
</tr>
<tr>
<td>PHA 6707C Developing the Next Generation of Pharmacy Faculty</td>
</tr>
<tr>
<td>PHA 6907 Directed Independent Study</td>
</tr>
<tr>
<td>PHA 6935 Special Topics in Pharmacy</td>
</tr>
<tr>
<td>PHA 6915 Pharmacy Longitudinal Research Project</td>
</tr>
</tbody>
</table>

$a$ Requires course approval to ensure content or project topics align with concentration for credit.

$b$ Course created specifically for the concentration.
test to their professionalism and ability to maintain an above average course load.

Cohort or class enrollment size was decided based upon three criteria: (a) course pedagogical design, (b) existing course capacity, and (c) program integrity. To promote optimal pedagogical design, aligning with Gamson and Chickering’s seven principles for teaching and learning in higher education, smaller class size was preferred (1987). For example, the design of the required courses in the program include small-group collaborative learning and one-on-one faculty mentorship to provide students a safe environment to attempt new teaching methods, engage with faculty, and allow for active learning with immediate feedback. The existing course capacity of the academic-based APPE was also limited due to faculty conflicting obligations to coordinate non-academic experiential rotations for the PharmD program. Finally, having a select small group of students promotes program integrity, the ability to select students who can maintain a positive image for the College and program. Therefore, the enrollment into the program annually is capped at 10 students, which is approximately 5% of the PharmD cohorts in their second and third year of the program.

Development

The development phase for the concentration included creation of curricular materials to support the delivery of multiple facets of the program. First and foremost, the new courses required syllabi creation and some existing courses to be included in the concentration required modifications to the student learning outcomes. Both the new and modified syllabi required formal approval from the College, University, and State. During this time, the University Graduate Council implemented changes to the course proposal process which required additional training and close collaboration with the Office of Academic Affairs to ensure proper submission and approval.

The student learning outcomes for all courses were mapped back to the program student learning outcomes to ensure all programmatic goals could be minimally achieved with the foundational courses in the plan of study. Elective courses would serve to enhance program outcomes as related to a specific population or focus. The faculty concentration coordinator and one instructional designer collaborated on the development of the initial syllabi.

Additional course specific instructional materials such as lesson plans, assessments, and rubrics required development for new courses. Materials were developed in collaboration between the faculty program coordinator and an instructional designer as they coordinated the Teaching Essentials course and lab during the inaugural years. This team also worked with the faculty coordinators of electives who aligned their electives with the program to promote consistency in assessments and graded rubrics.

The APPE rotation syllabi development was a bit more extensive than the other courses because one syllabus is utilized for all APPE elective experiences, regardless of the focus. Therefore, the faculty program coordinator and the instructional design team worked with the Office of Experiential Education, Assessment Committee, Curriculum Committee, and Office of Academic Affairs to ensure the global elective rotation objectives and experiential rubric aligned with the concentration goals. This meant that global objectives were very broad in the syllabus template for all APPE electives. The faculty concentration coordinator and instructional designer assembled a faculty advisory group to identify sub-objectives for the academia rotation along with standardizing the type of required assignments to meet the objectives.

Once all course outcomes and objectives were aligned with the concentration’s learning outcomes, the program of study was incorporated into the course catalog. This is considered a substantive change and required College and University approval. The original language in the course catalog included not only the courses for the concentration, but also the minimum applicant requirements (GPA, number of references, etc). This information was later removed and placed on the website. This allows for changes in the program applicant requirements without substantive changes from the University.

Multiple faculty would be assisting with instruction or coordination of courses in the concentration. To provide faculty with awareness of student learning during the first two courses in the program, a formal faculty book club was held in 2015 and 2016 to discuss the concepts covered in the required text book for the concentration. An instructional designer assisted in facilitating the book club.
in the inaugural year; thereafter onboarding has been managed by the program coordinator. New faculty to the College who are interested in facilitating or coordinating courses are required to read the textbook. The original instructional designer who helped design and start development of the concentration left the College. We have had two new instructional designers join the College. They both provide instructional design support, as well as classroom instruction. Having a fresh set of eyes on the program has brought new perspective on how to continue to grow the program as well as student collaboration in the process.

Part of the development phase included validation of course instruction. This process often utilizes small group trials with multiple iterations and with a minimum of two trials to determine if the courses and program are successful in achieving stated outcomes (Clark, 2015). The first two trials were comprised of students who were supplemental instructors in the College and had expressed interest in piloting the program. Although not all students who initially enrolled in the courses ended up completing the concentration, their formative feedback in informal evaluations were utilized to enhance the courses and other components of the program (eligibility, workload, marketing, etc.). Unfortunately, until the concentration was officially recognized by the College, formal course evaluations of the Teaching Essentials course were not released. All formative feedback was gathered during the last class each semester offered.

The major changes to the Teaching Essentials course from these evaluations were to enhance workload alignment with the semester credit hour allotment and Southern Association of Colleges and Schools definitions. The required number of teaching hours outside of the classroom time in the Teaching Essentials main course was decreased by 47% the first year, and then an additional 50% the subsequent year. The Teaching Essentials Lab originally required 15 hours of supplemental instruction in addition to creation of 4 hours of formally evaluated workshops. Students completed a workload evaluation in the second trial phase, and it was determined that the workload was closer to a 2 SCH requirement. Since the Lab is only a 1 SCH course, the required instructional hours was limited to only the formally evaluated instruction.

Additional materials developed for the concentration program, outside of course development, include marketing materials and student application documents. The program of study was placed on the College website after University approval of the concentration. This required creation of a webpage for all concentrations and dual-degree programs. The Office of Academic Affairs was integral in ensuring this information had a space on the website. The faculty concentration coordinator works annually with the website team to ensure all information is up to date. The information on the website can be used by faculty internally when advising students on whether to pursue the information, or for recruitment purposes for incoming students.

The program application was drafted two years into the program, seeing as the original students were limited to supplemental instructors interested in teaching. Once the program was approved by the Graduate Council, any student could then apply. Various faculty and the instructional designers reviewed the draft application and minor revisions were made. The inaugural students provided their perception of the minimum requirements to be successful in the program. From their feedback, the minimum requirements on the application did not change from the original program design. An increase in student inquiries about the concentration prompted the eligibility to be expanded beyond supplemental instruction to include other interested students.

There was an overwhelming amount of interest in the program once it was opened up to all students in 2018, so changes to the application for the next year included addition of a CV, a short essay regarding why the applicant is interested and how they see this program aligning with their career goals. In addition, the GPA requirements have been increased to ensure the students accepted into the concentration would be able to handle the workload and reflect positively on the College. A RXHE advisory committee was formed to assist with the selection of students and continued program development.

Although a formal procedure document has not been created, informal workflow processes have been created between the faculty concentration coordinator and the registration specialist to ensure students are enrolled in the appropriate classes according to their program of study. To help with this endeavor, a student-specific program of study was created for stu-
Students to plan what classes they would like to take during what year. This allows planning for both the concentration coordinator and the records and registration specialist. Furthermore, an enrollment Excel spreadsheet is kept to determine which students complete the concentration requirements to ensure conference of the concentration on their transcript and at graduation.

Finally, marketing materials were created for admissions recruitment. The College itself does not have a marketing department, therefore the faculty coordinator created this material with approval from the College and University. Continued development of marketing materials has been a challenge simply due to workload efforts. This may be an area of opportunity for student collaboration initiatives in the future.

Implementation

The timeline between development to full implementation of the program is slightly muddy due to the iterative nature of the ADDIE model where each component of the program is undergoing formative evaluation, improvement, and implementation. The development and implementation was staggered over a three-year timeframe. The first cohort of students in the RXHE concentration (starting with the HSC6261 Teaching Essentials course) enrolled in 2016. For these first two years, students from the supplemental instructional focus groups were allowed to pilot courses with the understanding that the concentration was in the development phase and may or may not be approved by the College before graduation. Six students enrolled in the Teaching Essentials course in the inaugural pilot year; of which three completed the concentration. The concentration was officially approved by the University in 2017, and the first cohort graduated in 2018. The formal student application first utilized in 2018 was revised as previously discussed. The updated application process was implemented for students wishing to enroll in 2019. The formative evaluations during the first two years of development have resulted in enhancements to the courses and other program components which are being implemented full scale for the new cohort. Per the iterative nature of the ADDIE model, formative evaluations of each component (courses, website, marketing, applications, program of study, faculty workload, etc.) will be ongoing during this implementation year.

Challenges surrounding the list of available electives has continued even as we implemented the program with a new cohort. The culture of the College is such that there has not been a list of standardized electives each semester. Faculty are given the option to voluntarily run electives based upon workload. Therefore, if faculty who offer electives aligned with the concentration decide not to coordinate an applicable elective, students may not be able to complete the concentration. The faculty concentration coordinator has been working with the Associate Dean of Academic Affairs and the College’s Curriculum Committee to alter this culture by requesting a standard list of electives that will be run annually, for a minimum of a 3-year plan. However, as one might anticipate, culture changes are often slow. When this challenge was first appreciated, additional elective options were added to the concentration plan of study in the catalog. Unfortunately, it was not possible to add electives which required a substantive change in the objectives to align with the concentration as the University Graduate Council has imposed a suspension on substantive changes due to University consolidation.

At this time the Departmental Chairs and Office of Academic Affairs are working with the program coordinator to ensure sufficient electives are offered in the future for the sustainability of the program.

Evaluation and Continuous Improvement

Throughout the development phase, various components of the program were formatively evaluated. For example, course evaluations and instructor reflections drove modifications to the instructional components of the concentration. Formative evaluations will continue to occur as part of the ADDIE process, especially as changes are made to each course.

Now that two cohorts of students have graduated the program, the concentration in its entirety is ready for a summative evaluation. The formal evaluation plan will utilize an internal evaluator and the CIPP Evaluation Model to measure and report on the selected variables. The CIPP Evaluation Model developed by Stufflebeam in 1971 was updated in 1973. Stufflebeam defines evaluation as “the process of delineating, obtaining, and providing useful information for judging decision alterna-
tives” (as cited in Fitzpatrick, Sanders, & Worthen, 2011, p.173). This is a four-step process to evaluate the context, inputs, processes, and products of the program. At the time of this writing, the program is entering into step three (Process Evaluation): Is the program being implemented as planned and what changes need to be made? (Fitzpatrick, Sanders, & Worthen, 2011).

The evaluation of the concentration will focus on three main areas. First, what are the benefits of the concentration to the students? Second, what are the benefits of the concentration to the college? Third, is the concentration sustainable? Benchmarks for appropriate variables will be derived from known PharmD program outcomes or standards set by comparative programs. For example, our College of Medicine currently offers scholarly concentrations for various foci; their current outcomes may set the standard for our concentration evaluation.

For the first evaluation question to determine benefits to the students there are three sub-questions. What is the benefit of the concentration to students? How do alumni feel/perceive the utility of the concentration after they have completed the PharmD program? How and where do the concentration alumni use the skills developed? Variables for this section include post-graduate training application and acceptance rates. Benchmarks for these metrics were set slightly higher than the current PharmD program reported outcomes, 50% and 80% respectively. We would like to include gainful employment rates, however the College response rate from alumni has been less than 70%, therefore we feel setting a benchmark metric compared to the College would be inaccurate. Additional data will be collected through alumni surveys and open-ended questions. Anticipated challenges include the aforementioned alumni follow-up response rate.

Preliminary metrics support the benefit of the concentration to students. Although alumni surveys have not been created, student relationships with the program coordinator allow ancillary quantitative data for employment and residency rates. All concentration alumni are gainfully employed in a pharmacy career. In addition, all applied to post-graduate training with an 86% acceptance rate.

Three sub-questions will be used to determine benefits to the college: What is the College’s return on investment? What additional scholarly projects have added value to the PharmD program? And in what ways has the concentration benefited USF Health and University? A cost benefit analysis will need to be completed on faculty time and course expenses to determine if the student metrics have a positive return on the college’s investment. Tangible cost savings include variables such as total instructional hours provided to the College, USF Health, and the Community by students in the concentration. Other metrics to identify benefit include the number of student and faculty publications, presentations, and awards, the impact on student recruitment, and course support.

Because a cost-analysis has yet to be completed, the net benefit of the concentration to the College is unknown; however, data thus far is encouraging. The total number of student-led instructional hours resulting from the con-

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>HSC 6261 &amp; 6261L Enrollment</th>
<th>COP</th>
<th>USF Health</th>
<th>Community Outreach</th>
<th>Clinical / Experiential</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-2017</td>
<td>3-6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>135</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2017-2018</td>
<td>9</td>
<td>102</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2018-2019</td>
<td>18</td>
<td>122</td>
<td>22</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. The first two years of the pilot required provision of workshops as part of supplemental instruction for the College, and significantly more hours in each course.

<sup>a</sup>A total of six students enrolled in HSC 6261 as a pilot group for the concentration. Three students continued with the lab.
concentration are outlined in Table 4. The number of intra/interprofessional workshops has increased throughout the program duration. Initial benefits to the College beyond supplemental instruction hours are a result of collaborative research and projects initiated by students throughout their progression in the program. For example, quality improvement initiatives have led to programmatic enhancements, including creation of courses for the concentration, student workload analysis, and programmatic mapping. In addition, students have taken the lead to present posters, manuscripts, and Scholarship of Teaching and Learning projects associated with the program. The magnitude of these projects and collaborative work with faculty or instructional designers has led to multiple AACP Walmart Scholar applicants and two students receiving this prestigious award.

Although the faculty and students at the college recognize the benefit of such a concentration (Hughes, 2018) the question remains as to whether or not this concentration helps our program stand out in the nation and if it is perceived by others to be beneficial. A prevalence and perception survey was created and disseminated to all accredited PharmD programs in the United States. From April through September 2018, there were 91 responses from 74 schools. Of those schools, 23 offered at least one concentration associated with their PharmD degree, yet only three offered one related to education/academia. Additionally, 68% of the respondents (n=76) to the perception questions indicated the completion of the concentration would be advantageous to very advantageous when interviewing for a faculty position. Responses varied more widely as to the extent which offering a teaching concentration would benefit the PharmD program offering it. Table 5 includes the breakdown of ratings.

Finally, the following three sub-questions will be utilized to determine whether the concentration is sustainable. First, is there enough student interest to continue offering the concentration? The benchmark metric established is whether there are at least ten qualified applicants annually to ensure maximum enrollment. Second, is there sufficient faculty to coordinate the core concentration courses? This metric will be answered through the standard reporting measures from Department Chairs regarding faculty workload. Finally, are there sufficient elective courses offered to meet the PharmD and concentration needs in a way that allows students to have choice? This data will be provided by the registration specialist of the College with a benchmark of at least two elective courses offered such that there is sufficient enrollment space for PharmD and concentration students.

Preliminary outcomes for sustainability are promising. Current student enrollment in the concentration meets benchmarks each year after the concentration was approved. The core courses of the concentration have been offered annually; four faculty members and two instructional designers have assisted with coordinating the core courses. In this manner, the courses can be delivered regardless of faculty teaching load. The third sustainability metric has been the most challenging due to the current format of faculty workload assignments. At the time of this publication although there are six elective courses aligned with the concentration program of study, three independent

<table>
<thead>
<tr>
<th>On a scale of 1-5, rate how advantageous you perceive…</th>
<th>Not advantageous</th>
<th>Neutral</th>
<th>Advantageous</th>
</tr>
</thead>
<tbody>
<tr>
<td>…a teaching concentration to be for PharmD students interested in academia/education. (n=76)</td>
<td>2</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>…a teaching concentration to be when considering applicants for an interview for faculty positions. (n=76)</td>
<td>3</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>…a PharmD student with a teaching concentration to be for the PharmD program offering it. (n=70)</td>
<td>5</td>
<td>7</td>
<td>23</td>
</tr>
</tbody>
</table>
studies had to be created to ensure a second elective option was available. This is due to the current culture of elective offerings at the College. A request has been made to provide a standard list of electives that will be run annually and assignment of electives to faculty workload to promote the sustainability of the concentration; however, from student feedback, it appears that the current electives cover enough topics that no new courses are needed. The quality of the courses contributes to the quality of the program as a whole. Therefore, the core courses in the concentration will follow the College’s course cyclic-review process as a part of the program evaluation. The cyclic review process evaluates courses minimally every four-years, and includes a review of student course evaluations. Formal course evaluations were first administered in Fall 2018 after the concentration had been officially approved and launched. Twelve students completed the course evaluations for HSC 6261 Teaching Essentials that semester. Almost all responses ratings to the ten statements were 4 or 5 (5 being the highest). One student selected 1 for all statements, but did not leave written comments, so no modifications can be made based on this response. Some constructive feedback from the comments included a desire for more opportunities to teach so they can demonstrate growth, request for timely feedback, and more modeling of effective teaching strategies by expert faculty.

The COP is committed to continual improvement of the program based on the data from the national survey, the feedback from students, faculty, instructional designers, and administration, and programmatic metrics. The instructional designers will continue to work with the faculty and administration to evaluate the program and facilitate the implementation of this valuable program. At this time, based on the included metrics, it is apparent that the concentration is benefiting the participating students and the College.

**Conclusion**

At this time, we perceive the RXHE concentration to be a successful addition to our PharmD program that has benefited both students and the college. The iterative cycle of analysis, design, development, implementation, evaluation, and improvement will continue with assistance from the design team to continue to monitor the programmatic goals and use the existing data points as benchmarks to evaluate the entirety of the program.

The collaboration between students, faculty, and instructional designers has been a vital component of the process. Including instructional design teams in this scenario is integral to ensure optimal program curricular mapping, assessment, and evaluation of the educational program. Collaborative practices have led to outcomes beyond programmatic creation, including program evaluation, focused growth of the program based upon student interest, and scholarly outcomes. The benefit of including students in the design and development phase cannot be overstated. This will be a component we continue to integrate for all newly created concentrations and programs.

There were several challenges faced during the creation of this concentration which resulted in important lessons learned. These included developing the curriculum, effectively utilizing resources, and attaining sustainability. The root challenge to each of these components was resource availability in terms of faculty workload. This is likely a common challenge faced by many Colleges. To initiate a concentration, all stakeholders and administration must have buy-in to provide support through the developmental years. Even with this support, resources may become limited at any time.

To mitigate these challenges, we have a few proposed solutions. To avoid potential pitfalls with creation of the program we recommend designating a concentration director at the outset of the program. Workload allocation should reflect the responsibilities of this position which include coordination of concentration, student advising, approval of courses for the concentration, faculty training, and resolving issues in a timely manner. To reduce the strain of additional resource needs and to promote sustainability, we recommend investigating the ability to have shared courses between Colleges, allowing transfer credits from outside programs, or even including a statement such as “additional courses suffice concentration requirements pending alignment with concentration goals and Program Coordinator approval.” This allows for flexibility if resources become restricted beyond control. Unfortunately, we did not include this in the outset of our program and were faced with sig-
significant challenges when the University imposed a suspension on substantive changes.

While these lessons learned will likely be applicable to any newly created program, the format of this concentration may not be generalizable to all Colleges. We allow both second-year pharmacy (PY2), third-year pharmacy (PY3) students to enroll in the concentration together, which can place difficulty in scheduling classrooms. Due to the cohort nature of our program, and internal classroom scheduling, we have some flexibility to make sure these courses do not have to be offered in the evenings; however, this may not be feasible at all institutions. This does make rescheduling classes for any reason, very challenging. Finally, if a program is year-round or has a greater credit-hour load per semester, the workload for students may be burdensome.

Overall, the addition of this concentration has proved to be a great experience for all involved and preliminarily appears to benefit both the College and the Students.

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References


Continuing professional development for healthcare professionals is important for the improvement and maintenance of skills and knowledge, and to ensure patient safety. With constant advances in healthcare research and practice, clinicians are required to stay up-to-date to provide evidence-based patient care. The clinicians’ knowledge and skills are also at risk of decay, especially if the knowledge and skills apply to situations that do not arise frequently. Not surprisingly, continuing professional development (CPD) is also required for healthcare professionals to maintain their licenses to practice.

What is often left unaddressed, however, is transfer of CPD to practice. This concern is not unique to CPD for healthcare professionals; it is a known issue with all training programs. For example, Saks (2002) reports that only 50% of training gets transferred into action by individual trainees. In their review of the training transfer literature, Burke and Hutchins (2007) conclude that trainers must provide follow-up support for learners to apply training in their workplaces.

Currently, training professionals are promoting microlearning use to support training transfer (Emerson & Berge, 2018; Graham, 2019; Kapp & Defelice, 2018). Microlearning refers to “small but complete learning experiences” (Quinn, 2015, para. 4) “that may provide any combination of content presentation, review, practice, reflection, behavioral prompting, performance support, goal reminding, persuasive messaging, task assignments, social interaction, diagnosis, coaching, management interaction, or other learning-related methodologies” (Thalheimer, 2017, para. 1). Consider the following application of microlearning to promote transfer. After a face-to-face class, the trainer sends a series of weekly follow-ups to participants. Some ask one or two questions to assess the extent to which participants recall basic terms and concepts;
some provide reminders on how to apply the skills taught in the program; some suggest unique applications of the material in environments relevant to some of the participants (but not others). A recent scoping review of the application of microlearning to healthcare education in the prelicensure context shows promise of microlearning for knowledge retention and skill transfer during studies (De Gagne et al., 2019). However, it appears that continuing professional development may differ significantly in terms of both individual and environmental factors that affect transfer.

Despite enthusiasm for microlearning among practicing training professionals, little empirical evidence is available to guide the design of microlearning in CPD or to provide insights into its actual effectiveness. We intend to begin filling these gaps by exploring the design of microlearning to supplement a CPD program for nurses and examining learners’ responses to that design. The specific research questions guiding this study are:

- Based on the literature, what are the key features to include in a microlearning program to support the transfer of training from continuing professional development of nurses?
- How well do those features support engagement of nurses with the microlearning and usage in the workplace for transfer support?

First, we situate the study in the literature by identifying key features that should be included in microlearning intended to support transfer of training. Then, we explain the methods used to conduct the study, and report the results of the design effort. We close by considering the implications of our findings to practice and research and theory.

**Literature Review**

In this section, we situate the study and our design for microlearning in the literature. First, we define the concept of microlearning and describe its use as a tool for promoting transfer of learning. Then, we identify key features that, according to the literature, should be included in microlearning to promote transfer.

**About Microlearning**

As noted earlier, microlearning refers to short, stand-alone experiences designed to address one to two instructional objectives (Hug & Friesen, 2007; Shank, 2018). Microlearning can take many forms, including videos, short instructional sequences, job aids, quizzes with feedback and brief case studies. Regardless of the form, the goal of microlearning is providing focused information on a specific topic a learner needs to readily apply the material (Emerson & Berge, 2018; Kapp & Defelice, 2018). Microlearning is similar to Electronic Performance Support Systems (EPSSs) (Gery, 1991) in that it brings learning to the workplace. But it is not an entire, integrated approach to assisting workers in performing their jobs. Microlearning is not the same as learning objects and shareable content objects (Wiley, 2002) which refer to components of learning that can be combined with other components to create an instructional passage. These objects can be as small as images or sentences. By contrast, microlearning is a complete, stand-alone lesson, albeit brief in length.

**The Role of Microlearning in Promoting Transfer of Learning**

Although microlearning may be used for many purposes, one of its most significant applications is in supporting the transfer of learning. Transfer of learning refers to the application of previously acquired knowledge to a real-world situation. Transfer has been described by Blume, Ford, Surface and Olenick (2019) as an iterative or dynamic process that does not assume (or even require) perfect performance on the first application but rather is realized over time. Training professionals posit that microlearning promotes transfer in the workplace by:

- Being consumable in a short period of time so that it is easily integrated into the workflow thus better integrating theoretical and experiential learning (Emerson & Berge, 2018; Gabrielli, Kimani & Catarci, 2005; Schachtner, 2005);
- Prompting recall of prior learning in a different time and setting which can be facilitated with spaced use of microlearning (Emerson & Berge, 2018; Thalheimer, 2017); and
- Providing adult learners with control over when they learn and the topic, so that it is most relevant and closer to time of application (Emerson & Berge, 2018; Gabrielli, Kimani & Catarci, 2005).
Key Features of Microlearning That Promote Transfer

To support the transfer of learning, the research and professional literature have identified a number of features that should be designed into microlearning materials. This section summarizes the most significant ones.

**Short length.** On the one hand, the literature recommends keeping microlearning materials short. On the other hand, the length of “short” varies, from as short as 30 seconds to 5 minutes from some authors to as many as 15 minutes (Kapp & Defelice, 2018). Eibl (2007) notes that the actual length should match the learning need, content and audience. When providing microlearning to learners, also indicate the length of time needed to complete the material (Eibl 2007) so learners can figure out if they have sufficient time to engage with it.

**Focused on just one or two messages.** Because of their brevity, microlearning materials should focus on supporting just one or two key objectives. But design and use of many microlearning modules are not intended for skill development; they actually have a more specific focus and only address a part of the skill development and retention process, such as providing a knowledge check, a reminder; and a specific application of material taught in another training program. Designers increase the chances of achieving these goals by clearly defining the purpose of the materials and avoiding extraneous materials. Such streamlined design also promotes learning goals by preventing an overload of working memory (Sweller, van Merriënboer, & Paas, 1998).

**Incorporate validated learning strategies.** Drawing on the science of learning, strategies should be used in the design that have a track record of effectiveness. Testing effect with feedback, error management training, storytelling and recall prompts are well established, effective learning strategies (Brown, Roediger & McDaniel, 2014; Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012). These strategies are not limited to any one teaching approach or method and so microlearning should also be designed to be interactive and employ learning science backed methods according to Emerson & Berge (2018). Contextualization of the information with scenarios and references to the work environment where application should occur is also a means of ensuring the learning is perceived as actionable and aligns with experiential learning strategies important for adult learning (Merriam & Bierema, 2013).

**A selection of topics.** Let learners choose a topic to briefly explore from a library of topics, so they can personalize their learning and support their individual transfer experiences. The autonomous selection of microlearning modules lets learners explore the material they are most motivated to learn or just about to apply. The concept of placing relevant, supportive information in a readily accessible platform that can be consulted while ‘in action’ is an extension of the concept of EPSSs, which provide users with a range of instruction and information they may need to perform work-related tasks in the context of their work (Gery, 1995; Carliner 2002). Although microlearning does not integrate as seamlessly into a workflow as an EPSS, it can still be placed for convenient reference in the context of a wide variety of job functions to be referenced as needed for completion of a specific action.

**Pushed microlearning.** One potential barrier to the success of microlearning is dependence on learners to engage with it solely on their own initiative; learners might not do so. One solution to this problem is to “push” microlearning to learners, sending either the instructional materials or messages containing links to it directly to learners. Ideally, microlearning would push messages to learners in a planned sequence and timed frequency, such as once every 3 days or once a week. Such timed follow-ups, also called subscription learning, place the information in front of the learner as a reminder of content and as a prompt to review which has been suggested by multiple training practitioners (Emerson & Berge, 2018; Kapp & Defelice, 2018; Shank, 2018; Thalheimer, 2015).

A subscription learning approach builds on the concept of spaced learning and may be incorporated as an element of transfer design with the goal of optimizing knowledge retention which is essential for knowledge transfer. Despite the evidence for the efficacy of spaced learning, it is a learning method that can be challenging to employ without a built-
in framework of support; learners may not be fully consciousness of their own knowledge decay. Additionally, engaging in delayed recall can make the user feel less assured in their knowledge in that moment, making it a hard learning method to sustain even if it will provide long-term gains (Brown, Roediger & McDaniel, 2014).

Although the literature has suggested a number of features of microlearning based on its current popularity in professional publications (Kapp & Defelice, 2018; Salas, 2017) there is surprisingly little empirical evidence demonstrating its effectiveness in the workplace (Duvernet & Whelan, 2017). Some features, such as microlearning as ‘just in time’ learning and as subscription learning, are primarily propositions in the literature and have not been empirically validated.

**Methods**

As noted earlier, this study explores these two questions:
- Based on the literature, what are the key design features to include in a microlearning program to support transfer of training from a continuing professional development of nurses?
- How well do the key design features support engagement of nurses with the microlearning and usage in the workplace for transfer support?

**Selection of Research Methods**

We determined that a descriptive approach would let us document the process of developing the microlearning and, later, validate that design with potential users. A case study fits with these goals and would let us answer the research questions in an applied setting. According to Yin (2009), “…case studies are the preferred method when (a) “how” or “why” questions are being posed, (b) the investigator has little control over events, and (c) the focus is on a contemporary phenomenon within a real-life context.” (p. 2). Each of these conditions were met by this study.

**How the Study Was Conducted**

To answer the study questions, a site was required where training transfer issues were present and microlearning could logically be integrated. Logistically, the site would have a CPD team facilitating a skills development workshop on a complex non-routine skillset, vulnerable to decay. We could piggyback on such conditions by designing and implementing microlearning to supplement the workshop, launching the microlearning afterwards as follow-up. Access to an adequate pool of potential participants was also key.

We selected as the study site, a tertiary care hospital in Canada with a CPD team providing regular workshops to nurses. To confirm participation in the project, administrators at the site signed a participation agreement. Participants needed to be nursing professionals working at the selected site, who attended the training, and who had:
- Achieved a score on the training post-test of 80% or higher, the level required to receive the CPD credits required for maintaining their nursing licenses. (The microlearning assessed in this study was intended to promote transfer, not support remediation.)
- An email account and an internet-connected digital device or computer to receive study information and links to access the microlearning.
- Given fully informed consent to participate in the study, whose protocol was approved by the ethics committees of the university and hospital (affiliated with a different university) where the study would be conducted.

**How Data Were Collected**

The study took place over the course of 8 weeks. The study had several phases.

**Phase 1. Designing the microlearning unit.** After sharing the schedule of upcoming training programs with the first author, the CPD group at the participating hospital and the first author determined that an upcoming program on evidence-based wound care for nurses would be used for the study. When the program had been given in previous years, feedback from participants identified it as content-heavy, and with limited informational supports for reference after the workshop. The program was a face-to-face 6-hour workshop that would be offered at the institution. At the end of the workshop, participants completed a post-test. Those who received 80% or higher would receive CPD credits. Although the workshop itself was not mandatory, those credits are required to maintain nursing licens-
es and therefore, a strong incentive to enroll and succeed.

The first author designed the microlearning to supplement this evidenced-based wound care workshop. The microlearning was intended for the same audience as the original workshop but with the goal of reminding participants of the training through three brief (up to 10-minute) online segments delivered one week after the end of the original workshop and available over the course of 3 weeks.

**Phase 2. Recruitment of participants during the workshop.** During the CPD facilitated workshop, a facilitator read a script to recruit nurses attending the workshop for participation in the study. Those who were interested in participating signed the consent form which were all collected in a sealed box regardless of consent response. To create subunits, we collected demographic data on nursing role, work unit and years of experience at the time of consent.

**Phase 3. Selection of participants and assignment to subunits.** After the workshop, the first author reviewed the collected consent forms and, using records of the test scores, confirmed the eligible participants.

To compare two recommended approaches to accessing the same microlearning, we assigned participants to two case subunits:

- **Micro-bits Subunit:** This subunit would receive the microlearning modules one lesson a week for a period of three weeks. This group would be informed by email each week that a microlearning module was available and provided a unique link to the new module, which would be stored on a Learning Management System (LMS) so use by individual learners could be tracked.

- **‘Whole shebang’ Subunit:** This subunit would receive access to all of the microlearning modules at the same time (one week after the workshop) and could take them at their leisure. This group would also receive notification by email informing them that the materials were available, but only at the start of time period of availability and their use, too, would be tracked by an LMS.

To ensure that the groups were somewhat balanced, the first author used demographic data provided earlier and ensured a balance of these characteristics between the two groups:

- **Nursing Role** (Management Role or Staff Nurse) relates to variables in the work environment that could affect the sources of support available after training and the opportunity to apply the knowledge on the job. For example, a nurse in a management role like a Nurse Educator could seek out more opportunities and share their wound care skills with colleagues but may have less peer or supervisor support than staff nurses.

- **Work unit** may also influence the opportunity to apply wound care skills as well as the ease of access to microlearning in the workplace.

- **Years of nursing experience** could influence a nurse’s self-efficacy, intention to transfer knowledge and the perceived usefulness of training.

**Phase 4. Participation in the microlearning.** One week after the training workshop, we invited participants to start the microlearning. Participants completed the microlearning modules in an LMS, which recorded and tracked their participation. The LMS recorded the date, time and duration of each microlearning session. It also recorded the responses to quiz questions embedded in each microlearning module as well as the time users spent answering each question.

In addition, the LMS administered a short survey at the end of each microlearning module, which included questions on opportunities to apply the wound care skills on the job and participant’s reactions to the training as well as intention to transfer learning.

**Phase 5. Completion of a post-microlearning survey.** The sixth week following the original workshop, we sent an email message to all participants linking them to a post-microlearning survey and asked them, regardless of the degree to which they used the microlearning, to provide descriptive information about their experience during the initial transfer period when microlearning was available. The online survey was hosted separately from the microlearning. It included questions about:

- **The total number of times they had an opportunity to apply their knowledge on the job;**
- Sources of motivation to do so;
- Whether they used the microlearning (If yes, where and when did they use it, and was it useful?); If no, why not and how could the microlearning be made more useful in the future?);
- Their preferences for assistance with care-related questions, such as a colleague, head nurse, or other source; and
- Intentions to apply the knowledge.

We piloted all questionnaires (the ones at the ends of microlearning modules and post-microlearning questionnaire). In response to comments during the pilot, we reworded questions to improve clarity.

**Phase 6. Participation in post-microlearning interviews.** The first author contacted participants during the sixth and seventh weeks after the workshop to invite participation in a semi-structured interview, whose goal was to gather descriptive data about the microlearning experience from about half of those who participated. Specific questions explored:
- Support received on the job to apply skills taught in training;
- Feelings of readiness to apply the skills taught in training;
- Use of the microlearning, including the location (such as nursing station or home) and closeness in time to actual application of the skills;
- Perceptions of the microlearning and motivations to use it;
- Extent to which they discussed the material with colleagues; and
- Suggestions for the microlearning.

**How Data were Analyzed**

With data captured at different timepoints during the initial transfer period, we were able to provide a detailed description of the microlearning follow-up initiative based on triangulating data from questionnaires, usage data and interviews. We first looked for themes arising from the data according to demographic groupings. Next, we compared data between the two microlearning delivery subunits (‘Micro-bits’ or ‘Whole shebang’) to identify similarities and differences. Then we looked for patterns and their prevalence (non-statistical) within the subunits and across the case in its entirety.

Descriptive statistics obtained from the questionnaires helped us to characterize the study participants and the composition of the microlearning delivery subunits. Usage data (frequency, timing and duration) collected over the period of time the microlearning was available allowed us to analyze patterns related to access type. We also used usage data to corroborate the self-report data collected through questionnaires and interviews. The mini-surveys at the end of each microlearning module provided us with a preliminary understanding of the timing of use in relation to transfer attempts and participant’s intent to transfer. This data was then more fully reflected at the end of the study through the final questionnaire and interview data. We coded the data from the final questionnaire and interview transcripts for emerging themes. Inferences and questions emerging from our analysis of this case are presented here. Together, these data sources provide us with a rich description of the design and use of a microlearning follow-up initiative during the initial training transfer period and of nurses’ response to the microlearning support.

**Assuring Credibility and Trustworthiness**

We took several measures to minimize the impact of bias on this qualitative study. To identify entering bias, we conducted a frame interview before data collection began. Methodological triangulation—that is, the use of multiple data sources—assured that we had several types of data and from several participants to analyze, assuring a larger data set from which to generate emerging hypotheses about use of microlearning. After analysis was complete, the study was also audited by another researcher unaffiliated with the study to assure that the resulting hypotheses and conclusions were consistent with the data.

**Results**

In this section we describe the results of our design efforts. First, we describe the CPD program the microlearning supports and the demographics of study participants. Then, we describe the microlearning modules, explaining how the key factors identified in the literature review were incorporated into the design. This section closes with us explaining how participants responded to the overall program and the specific design features.
About the CPD Program

We designed the microlearning to support a 6-hour face-to-face workshop on wound care for practicing nurses in the hospital. The main objectives of the workshop were taken directly from the training materials, but are not explicitly cited to maintain the privacy of the research site and participants:

1. “Determine a systematic approach to adult patient and wound assessment to optimize wound healing.”
2. “Compare and contrast the various types of wound dressings based on their form and function, availability and guidelines for use.”
3. “Describe VAC dressing application, removal and nursing responsibilities, when caring for adult patients on negative pressure therapy.”

The workshop had six units: (a) Principles of wound healing and the wound bed paradigm, (b) Management of acute and chronic wounds, (c) Prevention and management of incontinence associated dermatitis and intertrigo, (d) Negative pressure wound therapy and (e) Assessment and prevention of pressure injuries, and (f) Interactive group stations for demos and case scenario discussion. The workshop teaching strategy could best be described as a classical approach (Carliner, 2015). Although this study examined the design, development, and implementation of microlearning to support learning transfer, the workshop itself was designed before the study began and we did not contribute to its design or teaching. At the end of the workshop, participants took a multiple-choice exam structured around the learning objectives. Those who scored above 80% would receive credit, which could be used to maintain the nursing license.

About the Study Participants

Of the 52 nurses who participated in the workshop, 11 agreed to participate in the study. These included:
- Seven Staff Nurses, four who worked in clinics and three on units
- Four Nurse Educators, a management role with assigned clinical areas

Out of these participants a total of eight accessed the microlearning after receiving links to it by e-mail. All participants were female with years of work experience ranging from 4 to 28 years. All participants worked in adult care in areas ranging from Internal Medicine, Orthopedics, General Surgery, Plastics and Neurology. The three participants who did not access any of the microlearning displayed no demographic trend.

RQ1 Based on the literature, what are the key design features to include in a microlearning program to support transfer of training from a continuing professional development of nurses?

This section will report on the process of designing the microlearning based on what was suggested in the literature and the content of the CPD program.

Designing the Microlearning Materials. To prepare for the microlearning in advance of the workshop, the first author had about one-month lead time to design the materials. To do so, the facilitator of the classroom workshop provided workshop material from previous years, relevant hospital protocols and decision-making algorithms. The first author attained access to a Subject Master Expert, a Wound Care Specialist Nurse, for confirmation of selected microlearning topics, review of microlearning storyboards and for demonstration of a specialized dressing technique that was subsequently filmed. To ensure the information provided was evidence-based, national and provincial clinical practice guidelines were also consulted by the first author (Norton et al., 2018; Orsted et al. 2018; RNAO, 2016a; RNAO, 2016b [Video file]).

Because the first author is a licensed nurse in addition to an instructional designer, she is able to act as a Subject Matter Expert on the workshop material.

The first decisions we made addressed the objectives to cover in the microlearning. Underlying the decisions was the reality of applying wound care skills in a hospital: participants might have training but can only apply it when they actually see a patient requiring this type of care. That opportunity varies widely depending on the nursing assignment; some like surgical unit nurses could receive several opportunities a week while others like neurology clinic nurses might go weeks or months without needing to provide this type of wound care.

We decided to design microlearning corresponding to a supporting objective of each of the main objectives, for a total of three microlearning modules. Other design deci-
sessions focused on addressing the key features of microlearning identified in the literature (Gabrielli, Kimani & Carci, 2005; Emerson & Berge, 2018; Buchem & Hamelmann, 2010). Table 1 summarizes these decisions.

Based on these design decisions, we felt that the microlearning would support the transfer of learning from the classroom session because it creates a blended learning strategy, where complementary, interactive information is made available upon nurses’ return to the workplace that can be used as a form of what Eichenauer (2005) refers to as ‘aftercare’ to reinforce and extend what was learned. Such interaction with reinforcing information can counteract inevitable knowledge decay that occurs over time and particularly when a trained skillset is complex and opportunities to apply the knowledge are intermittent and unpredictable (Wang, Day, Kowolik, Schuelke & Hughes, 2013). This blended approach is recommended by Emerson & Berge (2018) but with an emphasis on ensuring the microlearning is interactive and employs learning science backed methods such as interleaving of practice and knowledge-checks.

Table 1. How key features from the literature were incorporated into the microlearning for this project

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<thead>
<tr>
<th>Feature</th>
<th>How the Microlearning Modules Addressed It</th>
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<tr>
<td>Short length</td>
<td>Modules could be completed in 10 minutes, including the time for the mini-survey embedded in each microlearning. We chose this length because it fell comfortably within the consensus-defined duration of microlearning (under 15 min.) and was a timeframe that could be fit between other tasks.</td>
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<tr>
<td>Focused on just one or two messages</td>
<td>*The first module focused on practicing wound classification using a case study and then adapting the corresponding care plan. A common error in wound classification was presented as the initial chart entry and the learner was prompted to either confirm or challenge the assessment. The learner then had to document the assessment using a simulation of the systematic documentation approach developed by the hospital. Next, the learner had to make a final decision on optimal care planning, referencing decision-making algorithms available in the hospital. *The second module focused on a review of wound dressing types based on their function according to the Moisture Balance Principle. The approach that we took was to introduce an analogy for the Moisture Balance Principle and then provide a job aid on the classification of dressing based on this principle, using examples of dressings commonly used in the hospital. *The third module focused on how to apply the VAC® dressing using a specific bridging technique. The approach that we took was to provide a 6-minute demonstration video showing the steps of the dressing application and basic machine programming with several trouble-shooting tips to common problems provided.</td>
</tr>
<tr>
<td>Incorporate validated learning strategies</td>
<td>We incorporated the testing effect in all of the microlearning modules, by including one to three questions on the topic of wound care that required application of the information either from the module or from related material presented in the workshop. Informative feedback was immediately provided once answers were submitted. We contextualized information for the transfer environment by referencing hospital-specific resources (charting templates, care plans and algorithms) as well as hospital-specific equipment and protocols. Module 1 employed a case scenario requiring error recognition and a corresponding adaptation in the care plan. Module 2 included an analogy with interactive elements to frame the Moisture Balance Principle and Module 3 included a video with synced audio to demonstrate a technique.</td>
</tr>
<tr>
<td>A selection of topics or pushed microlearning</td>
<td>Some of the learners received weekly prompts with timed access to an individual microlearning module and others received an initial set of e-mails providing access to all three modules at once.</td>
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Before development, the first author drafted the microlearning materials as storyboards (mock-ups of the intended learning materials). After expert review of the storyboards, the modules first author developed them using the e-learning authoring tool Articulate Storyline 3. The video-based module was filmed by the first author on-site at the hospital and then edited using Final Cut Pro X (Apple Inc., 2019), and who created the voiceover using Adobe Audition (Adobe Inc.). These materials required approximately 70 hours for development.

We pilot tested the modules using a think-aloud protocol with someone who was neither a nurse nor training professional to assess the usability of the materials. Two nurses who were not eligible for the study also provided feedback by completing a short questionnaire on usability and content. Prior to launch, an instructional designer from the hospital also reviewed the microlearning materials for usability and tested them on the hospital system to make sure that they ran properly. To make sure that the microlearning modules aligned with the actual workshop experience, the first author also attended the workshop and took detailed notes.

In order to track use of the microlearning, we placed the modules on a Learning Management System (LMS). The initial plan was for us to launch the microlearning on the hospital LMS with a unique URL linking learners directly to the modules. However, a lack of dedicated space for the microlearning from LMS administration meant that the microlearning had to be placed on the LMS by embedding it in pre-existing courses and the links generated did not take learners directly to the modules. Rather, users were routed through an unrelated course after an unexpected sign-in step which had not been the case during piloting. Multiple participants reported errors with the links provided in the e-mail notifications and being unable to locate the microlearning. For this reason, we re-launched the microlearning on an external LMS that provided one-click direct access to the microlearning as originally planned. Resolving this problem took about 3 days and required an amendment to the protocol and ethics review, delaying the launch of the microlearning by a total of 2 weeks.

**RQ2. How well do the key design features support engagement of nurses with the microlearning and usage in the workplace for transfer support?**

After finally implementing the microlearning, we collected data in accordance with the protocol described in the Methodology: usage data from the LMS, a questionnaire, and interviews.

**General Usage Patterns.** The LMS data provided information on use of the microlearning. Table 2 summarizes the general usage patterns.

These patterns surprised us. There was strong engagement with the microlearning by participants across the case regardless of de-

Table 2.

<table>
<thead>
<tr>
<th>Usage Parameter</th>
<th>Module 1: 8 minutes, 45 seconds</th>
<th>Module 2: 10 minutes, 6 seconds</th>
<th>Module 3: 9 minutes, 44 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average time spent per microlearning module (including short survey)</td>
<td>2.9 microlearning modules viewed per participant (only one participant completed just 2 of 3 modules)</td>
<td>5 at hospital office computer only</td>
<td>2 at both hospital computer and home computer</td>
</tr>
<tr>
<td>Average number of microlearning modules per participant</td>
<td>1 at home computer only</td>
<td>Micro-bits: 1.1 microlearning modules per session</td>
<td>‘Whole shebang’: 2 microlearning modules per session</td>
</tr>
<tr>
<td>Location of use</td>
<td>Average number of microlearning modules completed per session</td>
<td>Overall 6 repetitions during the study, performed by 4 different participants</td>
<td>Use on the same day as skillset applied</td>
</tr>
<tr>
<td>Repetition of modules</td>
<td>3 instances of same-day use as skill application reported by 3 different participants</td>
<td></td>
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</tbody>
</table>
mographic variables and regardless of the timing of access (all at the start or over time). However, the pattern of use between the two subunits differed; participants in the ‘Whole shebang’ subunit tended to cluster microlearning use together, often completing all modules on the same day rather than spacing out the use or, as someone characterized: binge watching the microlearning like a Netflix series. The only participant in the library access subunit that did not complete all three microlearning on the same day, still opened all three microlearning at once, completing two but returning to complete the third microlearning the following week. Participants in the ‘Whole shebang’ subunit were also the only ones to express in the final survey having difficulty finding time to complete the microlearning. This difficulty may have been related to the clustered use causing a longer overall duration of time spent on microlearning in any, one sitting compared to the Micro-bits subunit participants. As no participants from the ‘Whole shebang’ subunit participated in the interviews, one hypothesis about the clustered use came from a participant in the Micro-bits subunit who stated that if they had gotten access to the microlearning modules all at once: “E1: I would have probably did them all at the same time... because I know if I don’t do that, I wouldn’t go back.”

Of note, the participant reporting the greatest difficulty finding time to complete the microlearning was in the ‘Whole shebang’ subunit and accessed the microlearning uniquely from their home computer rather than at work. Another participant who participated in the interview related the use of microlearning at home to having difficulty finding time to do so at work on one occasion: “E3: the last one I did ‘rushed’ because I didn’t have much time. I think, I did it at home.” While the majority chose to use the microlearning in the workplace, participants are willing to complete microlearning at home if it is difficult to find time at work.

It was rare that microlearning was revisited by participants, regardless of the subunit and the opportunities to apply the skillset. This pattern was confirmed explicitly by the two nurse educators who were interviewed (both from the Micro-bits subunit), with one stating: “E1: I think I was doing it within the week that you had sent the e-mails with the link. Did I use it in purpose of teaching? Probably not. As a reference, probably not. More as a knowledge consolidation.” Of note, for the participants in the ‘Whole shebang’ subunit, the order in which the three microlearning were completed was variable. Since the microlearning had descriptive titles it is likely they were completed in the order of interest or relevance to the user’s practice.

The rare use of microlearning close to the time of providing wound care, just 3 instances, was also surprising as ‘just-in-time’ learning is one of the frequently cited rationales for microlearning support of transfer. Only one of the three reported instances was confirmed as an intentionally sequenced same-day use by the participant (a nurse educator) who reported in the survey that it was used for teaching prior to an application of the skillset with other nurses.

The questionnaire responses and interviews also provided insights into the responses of participants to specific design features. Table 3 (on next page) summarizes participants responses to these features.

In terms of transfer, participants had differing levels of opportunity to do so on the job. Three participants reported applying the skillset frequently (between 5-7 times and one participant on a near daily basis). Three participants applied the skillset occasionally (between 2-4 times) and there were two participants who rarely applied the skillset, reporting no opportunity to apply during the duration of the study. Despite the variation in transfer, the microlearning was still strongly used by the participants. For several participants the microlearning was described as facilitating active learning that brought them closer to the experience of skill application: “E3: sometimes at a workshop and...you listen to things and you know, you have so much information, right? And then, you’re not sure, if you sort of consolidated the learning and it’s by doing it, by doing it on the e-learning [microlearning] module, it makes you think differently.” Even for the participant who reported the most frequent training transfer, they still indicated that the microlearning would be the second resource they would use if they had a question about wound care, coming only after asking a colleague.

The supportiveness of the microlearning was consistently linked by participants with consolidating the learning from the workshop and facilitating recall of information.
Table 3.

How participants responded to the key features of microlearning identified in the literature

<table>
<thead>
<tr>
<th>Feature</th>
<th>How Participants Responded to It</th>
</tr>
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<tbody>
<tr>
<td>Short length</td>
<td>The short duration of the microlearning was associated with ease of use and completion by all interviewed participants as it facilitated its integration into workflow. The module could be completed in one sitting, uninterrupted by competing demands, as shown by the microlearning consistently being completed in a single time-sequence by all participants.</td>
</tr>
<tr>
<td>Focused on just one or two messages</td>
<td>The targeted information was associated by participants with better retention of the information because the microlearning design reduced cognitive overload. “N5: Yeah and it’s just they fill it [workshop] with SO much info… but this [microlearning], they were more compact and okay, on this, this, this and it was just…they were good. They were easy to, to do. They made sense.” It was suggested by a participant that the targeted information was especially useful when the topic was new or one not often used by the learner: “N5: For a level 1, beginner, it is easier to just have the basic, these are the steps you need, this is the product you need, this is how it all goes together. Which is what the microlearning did…”</td>
</tr>
<tr>
<td>Incorporate validated learning strategies</td>
<td>The testing effect was noted by participants as one of the most appreciated features. Quiz questions were specifically noted to prompt reflection and further processing of the information: “E1: Well it was helpful because sometimes I would go through the microlearning and I’m like: “Oh, I got the wrong answer, I was like: ‘Why did I get the wrong answer?’” because it’s a long day, the wound care workshop. So, sometimes we need a refresher on some of the theory or the background. And that’s I find it very helpful. It’s like: “Oh, yeah! Now I remember why.” There was a strong pattern of participants who noted the most helpful aspect of the microlearning was as a “reminder of the workshop.” The interactive nature of the microlearning was noted by all of the interviewed participants as a positive feature, seen as fostering active processing of the information and provided feedback on their decisions: “N5: It was interactive… Yeah, it makes it easier to learn. When you, see it and the screen reacts with you.” Two participants who were interviewed together stated that completing the microlearning made them feel better prepared to do a technique in their clinical area even though the need had not yet arisen since the workshop: “N4: No, we’ve never used a VAC, but just; in anything you have the theory, or somebody tells you but the minute you put it into action, you memorize things way…there’s more connections being made, right? So even though I will probably never use a VAC, I know how to use a VAC now…N5: I mean, more after the microlearning, than there [workshop]”</td>
</tr>
<tr>
<td>Contextualizing the information was also noted as helpful and was vividly described by one participant as: “E3: it’s almost the closest, if not the closest that we can have to the real thing … because the images are nice, everything is nicely done, so it brings you close to the clinical area.”</td>
<td></td>
</tr>
<tr>
<td>A selection of topics or pushed microlearning</td>
<td>There was no feedback specific to the ability to select topics from the ‘Whole shebang’ subunit. The majority of participants receiving the pushed microlearning (Micro-bits subunit) expressed that the one-week spacing between the microlearning delivery allowed them enough time to consolidate the information of each and that they did not feel rushed: E1: “I think it was good because I didn’t feel rushed to do them all at once. And, it gave me time to process information on the first one. So, when I arrived to the second one, I could focus on the second one.”</td>
</tr>
</tbody>
</table>
In terms of transfer, participants had differing levels of opportunity to do so on the job. Three participants reported applying the skillset frequently (between 5-7 times and one participant on a near daily basis). Three participants applied the skillset occasionally (between 2-4 times) and there were two participants who rarely applied the skillset, reporting no opportunity to apply during the duration of the study. Despite the variation in transfer, the microlearning was still strongly used by the participants. For several participants the microlearning was described as facilitating active learning that brought them closer to the experience of skill application: “E3: sometimes at a workshop and… you listen to things and you know, you have so much information, right? And then, you’re not sure, if you sort of consolidated the learning and it’s by doing it, by doing it on the e-learning [microlearning] module, it makes you think differently.” Even for the participant who reported the most frequent training transfer, they still indicated that the microlearning would be the second resource they would use if they had a question about wound care, coming only after asking a colleague.

The supportiveness of the microlearning was consistently linked by participants with consolidating the learning from the workshop and facilitating recall of information. “E1: So, I think it was just a good cue on: “Okay, I remember, that’s what they talked about. This is the etiology. This is why you are doing this instead of this.” It’s like, it’s good… “Oh yeah” … bringing back the memory of what you heard and what you learned during the workshop. I found it’s good like support.” For the final survey statement “Using the microlearning helped me remember some information from the workshop,” the most commonly reported level of agreement with the statement on a 5-point Likert scale was ‘4 = agreement’ (Range 4-5). Of note, the timed access subunit reported majority strong agreement (5) with this statement. This variation in agreement level between access subunits may have been linked to the usage pattern of the microlearning between the two subunits, where the ‘Whole shebang’ subunit tended to ‘binge’ the microlearning while the Micro-bits subunit had spaced usage. It was the only recorded difference in perception of the microlearning related to how microlearning was accessed.

Finally, the perceived utility of the microlearning was also attested to when participants recommended the microlearning should be made available to other nurses, even those who had not attended the workshop and they inquired if there would be more microlearning modules available: “E1: …I like that approach and I think we need more of those in the institution. Because we needed quick learning and we’re needing information to remember in the long term.” When asked if there was something that they would change about the microlearning, the majority stated ‘nothing’ while two participants specifically commented ‘Have more.’

The microlearning format facilitated its use at work and was summarized in the final questionnaire as “short, easy to navigate and interactive”; even quizzes were noted as helpful. These comments acknowledge the intentional design of the microlearning that used interactive features including decision-making scenarios and quiz questions with feedback to provide recall of workshop content and facilitate retention according to Salas, Tannenbaum, Kraiger & Smith-Jentsch (2012).

Conclusions

The data suggests that participants in this study appreciated and engaged with the microlearning, regardless of the level of opportunity they had to apply the wound care skills in their daily work. The key reasons that they appreciated the microlearning were the targeted learning, focused on just one or two messages, the brevity of the modules which for the majority could be easily completed in a single-sitting at work, and the interactive design of the modules, including the testing effect that served as a reminder of the workshop. That is, the results suggest that these are important features to users, either because users like them or they support the learning experience, and designers might emphasize these features in the microlearning they design.

The results of this case study do not validate the advantage of a selection of topics for ‘just-in-time’ usage of microlearning. Despite the accessibility and the short duration of the microlearning, only one participant indicated using it for ‘just-in-time’ use but not for their own personal reference. Rather, it was shared by the participant, who was a nurse educator, with nurses on the unit for teaching at a relevant moment; this could be considered
‘mediated just-in-time’ usage. Such sharing demonstrates an unintended but interesting use of microlearning which extends its use beyond solely independent access to that of a mediated resource that can be referenced during facilitated teaching sessions. Furthermore, it is hypothesized that having microlearning available over time may not be sufficient to prompt use in the moment of need without additional reminders of its availability such as promotion by nurse educators or e-mail reminders.

Instead, the usage pattern appeared to be influenced by the timing of access to microlearning (Micro-bits vs. ‘Whole shebang’ sub-units). There was evidence of a tendency to complete microlearning back-to-back when provided all at once. This clustered use however may reduce the efficacy of microlearning support of information retention as it takes away from the focused nature of the microlearning. Two participants from the Micro-bits group specifically mentioned that they used the microlearning for review and knowledge consolidation but that they had not returned to it for further consultation. So, if it is used as knowledge consolidation, then it should be provided in a way that optimizes this knowledge consolidation process, through spaced-learning. The ability to space out the learning through timed delivery will facilitate use, perception of use and retention of the information as it is not diluted with competing content. While the optimal spacing will vary by work context and schedules, in the context of this case study, optimal spacing is recommended to allow for at least one week in between learning sessions.

While there was strong usage exhibited across the case study, participants who received the microlearning by timed-access delivery reported that it was easier to find time to use the microlearning and also reported stronger agreement that the microlearning use helped them to remember information from the workshop. There were also differences in usage patterns depending on the type of access participants had to the microlearning. Those receiving library access tended to use the microlearning in clusters rather than spread out over time. The engagement with the follow-up microlearning was reported as fostering active processing of the workshop information and consolidating knowledge in a way that was closer to real world application.

The data suggest that microlearning, when deployed as follow-up support to workshop training can help by continuing the learning interactions once back in the workplace and during the time of initial transfer.

**Limitations**

Several issues limit this study. Some result from design choices: the microlearning supports a relatively short learning event (about 1 work day) and only includes three microlearning modules. The microlearning supported an elective, continuing professional development workshop—which is typical of training in a healthcare environment—but not a required training event, as would be more typical in other workplace settings. Although we followed a case study design, we had a sort-of experimental approach in which some participants received the microlearning one module at a time, others had access to all of the modules at once. However, the sample size was too small for testing of significant difference. The microlearning modules were all designed as e-learning modules rather than as a variety of different types of learning although different strategies were used ranging from case scenario to electronic job aid to video. And the microlearning modules were 10 minutes. Although experts suggest that microlearning can last as long as 15 minutes, others suggest much shorter modules (30 seconds to five minutes). Other limitations had to do with the size of the participant pool, only Micro-bits participants participating in the interview portion and the fact that the impact on transfer is self-reported and not measured using an objective instrument. The delay in launch of the microlearning, meant that more time elapsed between the workshop and participants’ access to the microlearning than was originally intended for this study. As a result of all of these limitations, the results do not generalize. But if designers and researchers consider these limitations in the context of their own plans to implement microlearning, the insights of this study might transfer.

**Suggestions for Future Research**

Although this study provides empirically derived insights into microlearning as a tool for supporting transfer, it is a small-scale qualitative study in a particular work context. Further study of applications of microlearning in other work environments that support dif-
different types of training events—or that are standalone ventures—should also be pursued.

Furthermore, variations in the microlearning approach might be explored. Not only should differences in availability (all at once? One at a time?), but also in the number of modules and their length.

The finding that learners “binged” on the microlearning should be explored further. Was this a unique result because of the circumstances of this study or is this a pattern that might be replicated in other situations?

Finally, could experimental studies of various conditions of microlearning be feasible, once the phenomenon has been better established empirically.

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