Game-Based Teaching and Simulation in Nursing and Healthcare
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Game-Based Teaching and Simulation in Nursing and Healthcare

Eric B. Bauman, PhD, RN
Throughout this book I have worked diligently to provide a collaborative multi-disciplinary approach to chapter content and expertise. To this end I would like to dedicate this book to two of my most cherished mentors, Professor Elisabeth “Betty” Hayes and Professor Emerta Mary Keller.
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The complexity of today’s healthcare systems demands that new graduates and professionals be prepared to care for acutely ill and complex patients in increasingly diverse settings. National leadership groups and organizations are calling for education transformation based on the *Future of Nursing Education* (IOM, 2011). Healthcare educators are now being asked to better prepare graduates to become knowledgeable workers and critical thinkers so that they can implement evidence-based interventions, and integrate emerging technologies into today’s complex healthcare systems. As a result, educators are assessing the ways in which current educational programs struggle to meet the needs of healthcare professionals today. They are searching for ways to better ready students for the complexities, realities, and challenges of today’s clinical practice settings. Educators are working to develop new approaches to current pedagogical methodologies that incorporate emerging technology into innovative, interprofessional, and internationally collaborative healthcare education. Foremost among new approaches are clinical simulations, virtual worlds, and interactive gaming, the topic and focus of *Game-Based Teaching and Simulation in Nursing and Healthcare*.

Clinical simulations, virtual worlds, and interactive gaming are types of pedagogies that transform the way we educate and prepare learners for clinical challenges. Simulations are a powerful strategy to engage and provide active learning with students; educators become facilitators of learning by creating interactive events and activities that reflect reality, where students can practice, acquire knowledge, and attain skills in a safe, nonthreatening environment. Simultaneously, students become active participants and controllers of their own learning when immersed in simulations, interactive gaming, or other emerging technologies.

This text has been written and disseminated at a perfect time. In answer to the call for educational transformation, healthcare education is under the microscope as its stakeholders explore best practices and methods to prepare the learners and practitioners we need today. Considering effective ways to teach today’s learners, Bauman and his co-authors have developed educational strategies using emerging technologies that have the potential to redesign our clinical education. The context-rich nature of games, virtual worlds,
and simulations provides examples of how nursing and other healthcare professional students can be prepared for clinical encounters and experiences. The situational models described in this book provide, controlled, and standardized environments where students can learn in an immersive manner. The authors provide an evidence-based, theoretically driven approach to implementing, integrating, and evaluating games, virtual worlds, and simulations into the curriculum for clinical education. While guiding the reader through the evolving field of virtual environments and game-based learning in nursing and healthcare, the book also discusses key elements such as curricular fit for these emerging technologies and research considerations for using them in today’s educational arena. Overall, this book provides the foundation for using and integrating these emerging technologies into the learning environment, thus becoming an important faculty development plan for health professional educators wanting to incorporate these strategies into their teaching. Finally, the authors provide many resources and examples for these emerging technologies on how and where they are being used.

Game-Based Teaching and Simulation in Nursing and Healthcare is written by educators who have been immersed in this technological world exploring, testing, and evaluating these methods of instruction. The book is a valuable resource for those embarking on the use of virtual reality, game-based learning, and the use of simulations in their teaching and learning practices.

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Preface

*Game-Based Teaching and Simulation in Nursing and Healthcare* provides educators with new and innovative approaches to preparing students for clinical practice and engaging nurses and other healthcare professionals in continuing education and lifelong learning. While educators now increasingly broadly adapt simulation into the curriculum, particularly mannikin-based simulation, related teaching pedagogies centered on game-based learning continue to represent less travelled and unchartered approaches to clinical education. This textbook draws from experiential learning models such as Benner’s “thinking-in-action” and “novice-to-expert” (Benner, 1984) frameworks and introduces contemporary learning models specifically designed to leverage technology to engage what Prensky (2001) has termed the digital native. These contemporary theories and frameworks are specific to games and simulation and include “socially situated cognition” (Gee, 2003), “created environments” (Bauman, 2007), “designed experience” (Squire, 2006), and the ecology of culturally competent design (Bauman, 2010; Bauman and Games 2011; Games and Bauman, 2011).

Innovative technology highlighted throughout this book moves beyond standard eLearning platforms and mannikin-based simulation to include technology that until very recently has been seen as a mode for entertainment, not education. The authors of this textbook advocate using the technology of video games and virtual worlds to engage today’s tech-savvy students in nursing and other clinical training programs with a host of expectations based on their sense of media literacy.

*Game-Based Teaching and Simulation in Nursing and Healthcare* encourages nursing scholars and educators and our colleagues across the health sciences to take a truly inter-professional perspective when approaching academic tasks such as curriculum development, implementation, and evaluation. By inter-professional we mean that various clinical disciplines ought to teach and learn together, but also that nursing and related disciplines must work in collaboration with experts in other fields who are driving the contemporary game-based learning and simulation movement. To this end, some of the brightest innovators in the fields of
educational technology, leadership, and curriculum and instruction collaborated, contributed, and co-authored various chapters and sections of this text, to pair clinical expertise with expertise among thought leaders in the game-based learning and simulation movement.

This text is divided into three sections. The first section focuses on language and theories that support simulation, game-based and virtual-world learning. The second section provides the reader with a “how-to” guide for integrating game-based learning strategies into curricula and the classroom. Section three offers strategies for assessing both teaching and learning that is steeped in game-based learning encounters. In addition, section three discusses the emerging research opportunities associated with game-based learning methods occurring in virtual environments.

The text also offers an appendix, which includes a broad sampling of game and simulation resources and products specific to clinical education, as well as a glossary of terms specific to the simulation and game-based learning literature.

Section one includes three chapters. Chapter one discusses the evolving field of virtual environments and game-based learning from a pedagogical and practical perspective. Chapter two stresses on the importance of multi-media literacy from multiple academic perspectives. Chapter three discusses the traditional theoretical underpinnings of contemporary pedagogy supporting the modern game-based learning movement and provides guidance on how educators can put these theories into practice now in their own classrooms with today’s students.

Section two includes four chapters. Chapter four provides a robust discussion and road map for preparing faculty and students success when leveraging game-based learning and virtual spaces. Chapter four details the importance of seeking out champions, developing advocates, and meeting stakeholder expectations. Chapter five builds on the theme of preparation, but focuses on how the technology highlighted throughout the text can be used to prepare learners for actual clinical environments. Chapter six addresses the concerns and challenges associated with integrating new technology, specifically game-based learning and simulation into existing and new curricula. Chapter seven centers on how game-based learning and virtual environments can and should be leveraged for the essential, but often neglected topic of cultural competency among pre-licensure candidates and more experienced clinicians transitioning to diverse professional roles. Even more important, chapter seven emphasizes not only the diverse patient populations that nurses serve, but also the increasingly diverse cultural climates that nurses and other clinicians
work in and among. This diversity emphasizes the need for innovative training opportunities that simply are not possible in traditional educational settings.

Finally, section three includes two chapters. Chapter eight centers on evaluation of both teaching and learning. When educators engage in new teaching methods it is important to evaluate these methods for effectiveness. In other words, is a game-based strategy effective in implementing curriculum objectives? And while it is always important to evaluate educators' teaching as a matter of best practice, it is essential when teachers are engaging new and innovative strategies. Chapter nine compels readers to seek out and identify research opportunities associated with game-based learning and virtual learning environments. Chapter nine provides the novice with basic concepts related to educational research and encourages all educators to become stakeholders in the research process. To accomplish this, the chapter provides examples and tips for research success based on the authors' experience.

In general, Game-Based Teaching and Simulation in Nursing and Healthcare provides strategies for developing, integrating, and evaluating game-based learning methods for nursing and healthcare educators. The text prepares teachers for the paradigm shift from static didactic classrooms and often asynchronous eLearning platforms to dynamic experiential learning that takes place in digital, virtual, and hybrid environments. The authors have included case studies throughout the chapters to help readers re-envision what counts for legitimate learning spaces and curricula. All of the contributors of this book urge readers to approach the material and discussion in this book with an open mind.

The aim of embracing new teaching strategies should be learner centered. Good teaching is generally not easy for the teacher, but it should be relatively easy for the learner. The vision of this book is to serve as an introduction and guide for teachers, administrators, and scholars who realize the importance of digital literacy, technology, and innovation for nursing and other clinical disciplines.

Eric B. Bauman

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Acknowledgments

In hopes of providing the reader with the best and most robust perspectives for applying game-based teaching and learning to nursing and clinical education, co-authors helped write and develop many of the chapters in this text. This book simply could not have been written without the collaboration of these colleagues.

In the spirit of multi-disciplinary and inter-professional learning I would like to say a little bit more about Professor Elisabeth “Betty” Hayes and Professor Emerta Mary Keller. Professor Hayes served as my doctoral mentor. With her encouragement I had the confidence to pursue a new field that few had heard about and even fewer understood. Professor Hayes was the inspiration for the “good game equals good simulation” epiphany that has shaped much of my scholarship. Dr. Hayes is one of the principles of the game-based learning movement and is currently a professor at Arizona State University.

Professor Keller was a member of the University of Wisconsin – Madison School of Nursing faculty from 1986 to 2006. I knew Professor Keller prior to entering graduate school; she was one of my first professors in graduate school. She taught my research methods course and provided me with encouragement through careful mentoring related to the style and effectiveness of my writing. Sadly Professor Keller succumbed to cancer in 2006 before I finished my graduate training, but not before she left a positive impact on countless nursing students and scholars.

In addition, I would like to acknowledge and thank Drs. Parvati Dev and William LeRoy Heinrich of CliniSpace™ for providing the images for the cover of this textbook. Finally, On behalf of all of the co-authors and collaborators I would like to thank Springer Publishing Company and our editor Margaret Zuc-carini and her many colleagues for their patience and guidance during this adventure. Without Margaret’s careful and thoughtful mentoring I am not sure this project would have ever been finished.
Game-Based Teaching and Simulation in Nursing and Healthcare
Language and Theory for Virtual and Game-Based Learning in Nursing and Healthcare
Evolving Field of Virtual Environments and Game-Based Learning in Nursing
ERIC B. BAUMAN AND MOSES WOLFENSTEIN

INTRODUCTION

In this chapter the authors review the history of the use of technology in clinical education. We begin with the introduction of early mannikin-based simulation and move through a discussion of the introduction and integration of high-fidelity mannikin-based simulation. Next, the discussion will advance toward the emergence and introduction of game-based learning and virtual environments and the role that they will come to occupy in nursing and other types of clinical education. This review provides an understanding of the path taken by clinical educators to introduce and use game-based learning in virtual learning spaces specifically created to produce targeted experiences for learners.

In this chapter we introduce the reader to the importance of understanding contemporary educational theory that supports the digital shift in nursing and clinical education in general. We will explore this theory in more depth in subsequent chapters. This said, many authors of traditional educational theory and nursing theory could not have anticipated the practice environments in which nurses have come to work, nor could they have imagined the role that technology has come to play in modern learning and clinical environments. This is not to say that traditional theory no longer has a role to play in nursing and other types of clinical education. It has never been appropriate for clinical educators to design curricula based only on tradition or historical practice. Rather, we argue in this text that understanding stakeholder expectations helps educational designers and teachers glean valuable lessons from past practice while they embrace contemporary educational theory that supports and even anticipates future clinical practice that represents the digital shift in educational practice.
In this chapter and throughout this text we stress the importance of ensuring that curriculum objectives drive game-based digital environments designed for learning, in this case clinical nursing education. Using technology for the sake of technology can confuse and frustrate students, teaching faculty, and staff. Not all course objectives are best addressed by using new or emerging technology. Selecting course objectives that leverage and provide a good fit for game-based learning is essential to ensuring the success of strategies for instruction that rely on multimedia environments.

**HISTORY OF EMERGING TECHNOLOGY IN CLINICAL EDUCATION**

Traditionally, educators have taught nursing and other health sciences disciplines by using familiar methods that saturate the early part of the curriculum with often redundant and repetitive didactic content from one course to another (Giddens & Brady, 2007). Teachers then slowly introduce students to hands-on clinical experiences. As students demonstrate a mastery of didactic content through traditional examination, teachers, clinical instructors, and faculty allow students to participate in more complex clinical encounters. The hope is that the students’ mastery of traditional didactic content will provide a translational context for increasingly complex clinical environments. To a large extent this process represents an apprentice style of education (Allan, 2010; Merriam & Caffarella, 2007).

Over the last decade, nursing and other clinical health sciences have begun to embrace and leverage technology to provide situated learning experiences. These experiences draw from previous and concurrent didactic lessons that help prepare students for new clinical environments and encounters. Simulation-based (SB) technology, specifically SB learning using high-fidelity mannikins is now commonplace in many undergraduate nursing programs (Shinnick, Woo, & Mentes, 2011). This said, historically various professions have employed SB learning in general to prepare students for professional practices that involve high-risk encounters that occur infrequently (DeVita, 2005; Gaba, Howard, Fish, Smith, & Sowb, 2001; Helmreich, 2000). Examples of industries on the forefront of SB learning include commercial aviation, maritime and commercial shipping, nuclear power production, and many aspects of military training (Bauman, 2007; Gaba, 2004; Schaefer & Grenvik, 2001; Shapiro & Simmons, 2002; Ziv, Wolpe, Small, & Glick, 2003). These industries continue to provide leadership in SB learning.

In healthcare, disciplines that routinely involve the management of complex, high-risk patient care settings have embraced SB learning, including trauma resuscitation, cardiac resuscitation, and anesthesia crisis management (Gaba, 2004; Lee et al., 2003; McLellan, 1999). While the introduction of high-fidelity SB instruction in the health sciences initially focused on high-risk, low-incidence event training, it is now being used much more broadly
as the literature supporting SB education has grown (Campbell & Daley, 2009). This is not to say that healthcare disciplines do not use various types of simulation, but rather educators now apply more complex technology to SB learning taking place within the context of nursing and other types of clinical education.

Teachers have employed low-fidelity simulation to introduce nursing students to the fundamentals of nursing care for many years. In fact, teachers have used mannikins for various forms of simple simulation in healthcare training for centuries. Ziv et al. (2003) discussed the role of early simulation dating back to the 16th century when “phantoms,” a type of simple mannikin, served as proxies for actual patients during obstetrical training and practice (Bauman, 2007). The contemporary beginnings of mannikin-based instruction in healthcare began with the introduction of Cardio Pulmonary Resuscitation (CPR) training. In 1961, several anesthesiologists tasked Asmund Laerdal, a Norwegian toy manufacturer, with creating a realistic mannikin suitable for teaching the technique of mouth-to-mouth ventilation. Shortly after Asmund Laerdal’s initial airway mannikin inception, Laerdal enhanced the airway mannikin to include an external cardiac massage component (chest compressions). This simulator, known as the Resusci-Anne® and others like it continue to be used today to train thousands in CPR. The Laerdal Company now manufactures many medical devices, a host of comprehensive and complex patient simulators, including the SimMan® 3G (Grenvik & Schaefer, 2004). In the last 10 years the number of manufacturers making and distributing simulators designed specifically for nursing and health sciences education has grown exponentially. More recently, Laerdal has embraced the paradigm shift toward multimedia and online learning by producing distributive learning modules for a variety of clinicians.

While Resusci-Anne® was being developed in Europe, other mannikin-based simulators began to emerge in the United States, including the Sim1 (Cooper & Taqueti, 2004; Lane, Slavin, & Ziv, 2001; Tan, Ti, Suresh, Ho, & Lee, 2002). Stephan Abrahamson, an engineer, developed Sim1 with physician Judson Denson in the mid-1960s. Cooper and Taqueti (2004) called Sim1 the “starting point for true computer-controlled mannikin simulators, particularly for simulation of the entire patient” (p. 112). The advantage of the Sim1 and other simulators like it was that it provided a platform for teaching specific tasks, including endotracheal intubation, an advanced airway skill. This allowed potentially dangerous skills like endotracheal intubation, which is an invasive procedure, to be taught in a manner that eliminated risk to patients. Basic proficiency could be taught, mastered, and evaluated through simulation allowing novices to become proficient prior to attempting the procedure on an actual patient (Gordon, Oriol, & Cooper, 2004). Medical Education Technologies, Incorporated (METI) of Sarasota, Florida (now CAE Healthcare, a Canadian company) eventually developed a full-scale, comprehensive, complex mannikin, that combines various aspects of task or procedural training with
dynamic human patient physiology software capable of modeling numerous patient conditions, pathologies, and related treatment modalities.

Substantial information sharing between health sciences and engineering disciplines related to SB education is a relatively new phenomenon. The jump from the rather simple Resusci-Anne®-style simulator to the modern, more comprehensive simulator capable of modeling human physiology took place within the high-acuity field of anesthesiology, and to a lesser extent, cardiology (Cooper & Taqueti, 2004; Hammond, Bermann, Chen, & Kushins, 2002; Howard et al., 2003; Kneebone, 2005).

Physician Michael Gordon developed a simulator known as “Harvey” in the 1960s and first demonstrated it in 1968. Gordon designed Harvey, named after Gordon’s mentor, W. Proctor Harvey, to simulate various cardiac conditions to develop students’ cardiac diagnostic abilities. The Harvey simulator also provided a standardized comprehensive platform for evaluating students (Cooper & Taqueti, 2004). The ability for instructors to introduce a standard platform that can be consistently integrated into curricula over time is one of the hallmarks of the SB learning movement. Standardization affords all students the same educational experiences in preparation for independent clinical practice.

In the 1980s, innovators developed several other anesthesia-specific simulators and introduced them into health sciences education. David Gaba, a Stanford Medical School physician, developed the Comprehensive Anesthesia Simulation Environment (CASE). He designed the CASE system less as a mechanism for honing clinical assessment or task-specific skills like intubation or airway management, and more as a system for evaluating the human response to critical events in terms of performance assessment and behavioral response (Gaba, 2004). Physician Michael Good and J.S. Gravenstein, an engineer at the University of Florida, were also developing the Gainsville Anesthesia Simulator (GAS) in the 1980s. Unlike Resusci-Anne® and Harvey, the anesthesia-specific simulators were designed not as task trainers, but as mechanisms to increase patient safety and positively affect patient outcome before, during, and after students’ training (Bauman, 2007; Cooper & Taqueti, 2004).

The shift from using simulators to teach and evaluate specific tasks to be mastered by students, to using simulators as the stage or platform for designing, implementing, and evaluating behavioral change demonstrates the important shift in how technology can become integrated into existing curricula. We might consider leveraging virtual simulation that takes place in game-based or virtual environments in the same way we have in the now familiar mannikin-based simulation laboratory. The mannikin-based simulator must exist in a fixed location, a laboratory or in situ, and is often only accessible to students based on schedules that are designed around institutions’ business hours. Further, even a modest single mannikin simulation laboratory can cost well over $100,000 in initial capital costs alone. Game-based learning environments existing in digital or virtual reality environments literally play by a
different set of rules. Virtual environments do occupy space, but in a very different context that challenges the conventional notions of time and real estate.

THE DIGITAL SHIFT: FROM THE CLASSROOM TO THE SIMULATION LAB
ON THE WAY TO VIRTUAL OR GAME-BASED ENVIRONMENTS

Educators can and should harness new methods of instruction that use technology to prepare nursing students and other health sciences students for those experiences that cannot be guaranteed during traditional didactic and clinical methods of education. As the role of the registered nurse continues to grow in terms of clinical complexity and professional and personal liability, it becomes more challenging but evermore important to prepare new graduates for the types of complex patients and environments they will encounter in actual practice. Unfortunately, traditional modalities of nursing education cannot consistently guarantee exposure to all of the relevant clinical educational opportunities needed to prepare students and later new graduates for the transition from novice to expert (Benner, 1984; Benner, Tanner, & Chesla, 2009; Larew, Lessans, Spunt, Foster, & Covington, 2006).

This is not to imply that graduating students should enter their professions as experts, but instead to imply that new graduates and novice clinicians must be able to enter their professions with valuable experiences to build on as they attain clinical expertise (Benner et al., 2009). Clinical encounters of educational value need not be left to chance; these situations can be designed through simulation and game-based learning to ensure that all students have the opportunity to experience consistent curricula and comprehensive instruction (Bauman, 2010; Bauman & Games, 2011; Friedrich, 2002; Games & Bauman, 2011; Gordon et al., 2004; Lane et al., 2001; Shapiro & Simmons, 2002; Ziv et al., 2003).

The traditional nursing laboratory provides learners with a physical space to engage in the many tasks of nursing in a safe environment, without risk of negative consequence to patients while attending to the relative emotional safety of the learner. In the traditional nursing laboratory, students are introduced to skills such as bed making, bathing, wound care, sterile technique, and later more complex skills such as patient interviewing and assessment. Traditional nursing skills laboratories generally include a number of low-fidelity mannikins that allow students to learn and later be evaluated on any number of skills associated with nursing practice. These traditional laboratories continue to play an important role in nursing education. Adding high-fidelity simulators and game-based learning environments into the curriculum simply because they are available often leaves learners confused and teachers frustrated. Exploring and understanding where and when to leverage this technology is essential to successfully integrate the technology into the curriculum.
For example, using a $100,000 mannikin simulator to teach students how to change linens with a patient in the bed is a poor and expensive proxy for a simple low-fidelity mannikin or a standardized patient who could very well be role-played by another student. Similarly, students will not glean any haptic feedback from starting an IV or completing a blood draw in a digital game-based virtual environment.

Instead, educators should see game-based learning as an integrative step toward supervised clinical practice and eventual independent clinical practice. Game-based learning in virtual environments should also be seen as a step toward actual practice, just as SB learning in a fixed or created space serves as an integrated step toward practice in actual clinical environments (Bauman, 2007; Bauman, 2010; Bauman & Games, 2011; Games & Bauman, 2011).

Mannikin-based simulation acts as an intermediate step between didactic preparation and the actual clinical environment. It allows students to perform in a created environment (Bauman, 2007; Bauman, 2010; Bauman & Games, 2011; Games & Bauman, 2011) complete with specifically designed experiences (Squire, 2006) that have been engineered to provide meaningful encounters that prepare students for actual clinical environments. A schematic of this process is found Figure 1.1.

The Simulation to Practice Pathway initially served as a mechanism to illustrate how teachers could integrate mannikin-based simulation into their existing curriculum (Bauman, 2007). While this process was never meant to be entirely linear, it provided a starting point for a “how-to” discussion for those interested in embracing mannikin-based simulation as a method for clinical education. In this pathway students must be prepared for the SB experience. From this perspective, including simulation in the curriculum does not
obviate the need for basic knowledge acquisition. This preparation, or knowledge acquisition can take place through traditional didactic pedagogical approaches. In fact, a traditional didactic approach is often the most appropriate and sensible approach given the audience and constraints associated with clinical education.

The principles of andragogy support adult learners as self-motivated students who are able and willing to take responsibility for many aspects of their educations (Merriam & Caffarella, 2007). Students who enter SB learning environments without adequate orientation to these environments and the situated content teachers reinforce often find their experiences to be confusing and frustrating. Orientation is an important facet of any learning experience. Students who are unfamiliar with the advantages and limitations of virtual spaces will require a tutorial or an orientation phase to the new virtual learning environment medium. Teachers familiar with virtual worlds sometimes refer to this phase as a \textit{walk through}. The \textit{walk through} provides learners with the opportunity to explore \textit{in-world} environments with or without an active tutorial. Just as it is important for students to be adequately prepared for supervised clinical environments, it is also important for them to be prepared for situated learning experiences that leverage SB learning in fixed laboratories or in virtual environments (Bauman, 2007).

When done well, particularly during initial training, the simulation laboratory provides an important place for instructors to test the waters with their students who may be operating at the edge of their knowledge base in a safe environment that provides experiences specifically designed to support later learning and actual practice (Bauman, 2007; Squire, 2006). As we embrace the digital shift in higher education, how we define the clinical laboratory and simulation laboratory will shift from fixed, created spaces to include virtual and online spaces often encompassing game-based learning scenarios.

As educators continue to recognize games, \textit{serious games}, and game-based learning as legitimate pedagogical tools in kindergarten through high school education, and in higher education, including professional, clinical, and technical education, it becomes necessary to examine how and where educators can best leverage games to enhance student experiences that provide translational utility. The inclusion of games in the curriculum must aid the learning experience not only from the aesthetic perspective, but also through the ability to better prepare students for actual clinical practice. From this perspective we are not arguing that games and game-based learning should replace SB learning found in fixed spaces or that they somehow replace the didactic component of clinical education. Rather, we argue that educators can and should see game-based learning as an available resource to engage students in meaningful experiences that inform both their educational experience and future clinical practice. The rethought simulation to practice pathway below demonstrates the role that game-based learning should play during clinical education and is shown in Figure 1.2 (Bauman, 2010).
The *Rethought Simulation to Practice Pathway* incorporates games as an integrated process beginning at the knowledge acquisition level. Game-based learning in this model begins as an integrated component of learner knowledge acquisition. Again, the model is not meant to be linear. Nor should educators see the integration of games into curriculum as an opportunity to be engaged only at the beginning of a learning process or curriculum. Also note that when educators integrate game-based learning into the traditional didactic phase of clinical education, they provide an active behavioral component that situates learner experience. Adding the *behavioral* facet as an accompanying component to the *knowledge acquisition* phase of this model is quite deliberate.

Traditional forms of didactic presentation are content oriented. They are static and do not engage learners through interaction based on narrative, decision making, and consequence. This is not to say that traditional didactic content cannot include narrative components. Instead games have the potential to engage learners differently than traditional aspects of didactic presentation, such as reading assignments or lectures.

Addressing behavioral expectations associated with the clinical environment is very difficult to do in the traditional didactic component of nursing and other clinical sciences disciplines. Static content simply cannot model behavior and introduce the social and professional mores associated with professional practice in the same way that an interactive game-based environment can. Further, the interactive game-based environment allows students to test their knowledge in a venue that is contextually situated in terms of patient and professional consequences related to decision making. Asking students to think about how their personal presentation, interpersonal communication style,
and decision making might affect future practice and encourage students to reflect but does not necessarily engage them. An interactive game-based environment provides students with an experience specifically engineered to introduce students to specific targeted objectives (Squire, 2006). Moreover, sharing an experience together, perhaps in a virtual world, is a more powerful reflective experience than talking about similar experiences that learners have experienced independently elsewhere (Tyczkowski, Bauman, Gallagher-Lepak, Vandenhouten, & Resop Reilly, 2012).

The digital shift in nursing and clinical education is occurring throughout curriculum. As discussed above, digital educational interventions are changing the way we present basic or introductory information to novice students. Many teachers have come to equate digital leaning with online course work. However, while online courses have made great strides in terms of addressing the challenges of time and location, they often fail to engage students any more than a traditional lecture style course. In fact, some have argued that online course work that is not carefully designed to specially include student interaction is often even less engaging than traditional classroom learning (Browning, 1999; Sharpe & Hawkins, 1998).

WHY IT IS ESSENTIAL TO UNDERSTAND THEORY THAT EMBRACES THE DIGITAL SHIFT

While emerging digital learning technologies have begun to transform teaching and learning in healthcare simply as a result of their growing popularity in clinical education settings, it is essential for teachers and faculty who use them to understand the theoretical models that have given rise to these tools so that they can deploy them effectively. Digital simulation and game-based technologies have both grown up alongside a number of learning theories and stimulated the development of new theories in a variety of fields. While Chapter 3 of this book will look at game-based theories in greater depth, this chapter offers an introduction to a few of the more prominent theories tied to digital media and learning: constructionism, socially situated approaches to cognition, and the theory of designed experience. All three theoretical orientations tie in the idea that learning is best supported through interaction, and hence essential when designing, integrating, and evaluating both simulations and games.

The theory of constructionism developed by Seymour Papert is a direct descendant of the much more widely known theory of constructivism developed by Jean Piaget. While constructivism substantially predates digital technology, constructionism retains a number of its core features while translating them into a more contemporary context where digital media plays a central role. Both constructionism and constructivism share an emphasis on knowledge that is constructed by the learner rather than transmitted by the teacher. For Piaget, this was a move against the prevalent assumption that knowledge
was external to the mind, a key feature of the “transmission model” of learning then in vogue. For Papert, it involved both elements of constructivist theory, and a desire to “push back” on persistent education policy initiatives that focused on improving the quality of teaching rather than the quality of learning (Papert, 1980).

Ultimately, Papert’s constructionism is a pragmatic instructional theory, while constructivism (Piaget) is both cognitive and philosophical in nature. However, at their core both focus on knowledge building through experiences. Papert and Harel (1991) described the relationship between the two theories by noting that they share a “connotation of learning as ‘building knowledge structures’ irrespective of the circumstances of the learning” (p. 1). However, for Papert, the ultimate aim of advancing constructionism was not so much to understand learning in the capacity of development, but to reframe how we approach learning with a renewed emphasis on the making of things as the most essential aspect of real learning.

In the context of simulation and game-based learning, Papert’s explicit emphasis on learning through building something may seem less applicable at first blush. However, it’s worth noting that Papert developed constructionism primarily around mathematics where displays of student learning have been traditionally limited to decontextualized or un-situated performance via paper and pencil testing. The development of constructionism can be seen in part as a way of emphasizing that as computers are brought into learning experiences, they should not be used to replace instructors, but to create opportunities for students to learn by doing (Papert, 1980). In the context of using simulation and games to prepare students for clinical encounters, constructionism serves as a reminder that simply requiring students to use these technologies may be necessary but not sufficient to create deep learning opportunities. Instead, teachers need to provide students with chances to rearticulate their experiences of learning with digital media and engage in authentic discourse with peers and mentors regarding the learning activities they encountered in the digital environment.

While constructionism draws from Piaget’s theory of constructivism, many researchers who have theorized on cognition as a socially situated phenomenon draw on Lev Vygotsky’s similarly named theory of social constructivism (Vygotsky, 1978). The core element of social constructivism that learning takes place through a complex array of social and cultural interactions is reflected in a number of learning theories and mobilized in work related to game and SB learning. In addition to technical artifacts like mannikins and curricula, the term also refers to social and cultural artifacts such as symbols and systems of organization (such as numbering systems and languages). Nursing and other clinical sciences are rich with both technical and cultural artifacts. New students often struggle with the language and system of organization inherent to nursing practice as they learn how to communicate using new terms and systems of diagnosis that are essential to competent practice.
The core tenets of social constructivism have fueled a great deal of thinking around how digital media artifacts function within learning systems. Social constructivism highlights not only the ways in which game and simulation tools remediate learning for individuals, but also the different ways in which educators can leverage these tools in various social and cultural contexts. Vygotsky’s theory of social constructivism also pushes instructional designers, teachers, and researchers to think about the relationship between the development and use of situated social and cultural artifacts found within the digital environment.

The basic concept that learning is best understood by looking at interactions between both humans and nonhumans, in this case technology, is taken up time and again by learning theorists who have defined the field of digital media and learning, like John Sealy Brown (Brown & Duguid, 2001) and James Paul Gee (Gee, 2003). Researchers Jean Lave and Etienne Wenger, whose concept of communities of practice (Lave & Wenger, 1991) have also greatly influenced the development and study of various digital media forms for learning. The common thread among these researchers and their theories is that they stem from the fundamental enterprise of viewing learning as a socially situated activity.

James Paul Gee’s *What Video Games Have to Teach Us About Learning and Literacy* (2003) is arguably the most seminal work in the study of video games and learning. In this work, Gee points to both the manner in which games function as well-ordered problem spaces, and the manner in which player communities enable powerful learning experiences (2003). In the context of schools, Gee has subsequently emphasized that games are hardly a universal remedy, and that he is not actually advancing an agenda around games and learning per se. Comparatively, games offer us representations of what he calls “situated and embodied learning.” Gee explains this concept as “being able to solve problems with what you know. Not just knowing a bunch of inert facts, but being able to use facts and information as tools for problem solving in specific contexts.” (Brown, 2011).

Similarly Brown, Collins, and Duguid proposed the concept of “cognitive apprenticeship” as a means of conveying the manner in which learning is inherently situated within specific sociocultural contexts that inform possible applications of knowledge (1989). Both Brown and Collins have subsequently written separately in great depth around the topic of learning and digital media (Collins & Halverson, 2009; Thomas & Brown, 2011). However, even prior to the rise of these authors’ perspectives on media and learning they advanced a fundamental theory with extensive implications for using digital games and simulation for learning. These authors noted that, “…people who use tools actively rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves” (Brown et al., 1989, p. 33). This notion clearly reflects the same approach Gee adopts in pointing to the difference
between situated understandings and the acquisition of inert facts or un-situated didactic content. Brown et al. go on to note that, “Learning how to use a tool involves far more than can be accounted for in any set of explicit rules. The occasions and conditions for use arise directly out of the context of activities of each community that uses the tool, framed by the way the members of that community see the world.” (p. 33).

Brown, et al. have presented an important insight into what it means for cognition to be socially situated, and one that clearly illustrates the implications of learning theory in the development and integration of game and simulation technologies. Learning is not only bound to specific contexts, as has been illustrated extensively through the literature on knowledge transfer (Bransford & Schwartz, 1999), but the application of learning is bound in cultural norms and via individual’s understanding of said culture as well. In terms of the design of digital tools for learning in clinical disciplines such as nursing, this means ensuring that the representation of nursing practice includes an adequate representation of context in order for the learner to not only understand technical and nontechnical aspects of the nursing practice, but also to know when and how it is appropriate to implement those various approaches and procedures. Successful implementation of media-based technology, including game-based learning into the curriculum must emphasize the socially situated nature of cognition and how it serves as a reminder that where and at what point technology-based media tools are integrated into the learning process can be crucial in ensuring their efficacy.

Before games and simulation saw widespread use in educational settings, theorists were already advancing frameworks that have helped us make sense of how digital resources work to restructure human cognition and learning. While some of the previously enumerated 20th-century theories centered on the sociocultural and psychological aspects of learning in general, they would later be adapted to provide the pedagogical underpinnings for incorporating games and simulation into educational settings. However, even before theorists began focusing on the situated sociocultural aspects of learning, the importance of educational design and its relationship with learner experience was being explored. As early as the 19th century, Friedrich Froebel, while creating the system of kindergarten, defined early childhood education through the development of a carefully crafted series of designed interactive “gifts” (Brosterman, 1997). The moniker “kindergarten” for preelementary education would of course stick, even as the details of Froebel’s carefully designed educational experience would fall away in favor of more generic learning structures. However, the concept of designing learning opportunities would be taken up again by a number of other learning theorists between the 19th century and the present day.

Chapter 3 explores the development of theories that look at the development of learning spaces as a design activity in much greater depth. For the purposes of gaining a basic orientation to digital learning resources as designed or
created spaces (Bauman, 2007) in this introductory chapter, we will consider recent work by Kurt Squire which looks specifically at video games as designed experiences. While Squire’s theory of games as designed experiences departs from the same socially situated assumption that other scholars have pointed to, he goes on to interpret how it is that video game designers work to create powerful learning experiences even in those games that have been designed primarily for entertainment (Squire, 2006).

Squire specifically notes that a game “...provides a set of experiences, with the assumption being that learners are active constructors of meaning with their own drives, goals, and motivations. Most good games afford multiple trajectories of participation and meaning making. Content is delivered just-in-time and on demand to solve problems” (Squire, 2006, pp. 24–25). Here Squire points to three distinct traits of high-quality video games as designed experiences that make them particularly effective for certain types of learning. He emphasizes the manner in which good game design sets up conditions for the learner to drive their own learning through the creation of meaningful goals. He emphasizes the fact that most good games provide more than one route toward mastery, thus allowing different learners a variety of ways to approach the task. Finally, he emphasizes a point that has also been highlighted by Gee (2003), that scholars concerned with assessment have since recognized as an essential feature of games for learning (Shute, 2011): games deliver new content in the support of specific contexts “just-in-time and on demand” in order to help players solve problems.

In the context of nursing education and other clinical learning, Squire’s theory of games as designed experiences (and other design-centered theories of learning) have obvious import. In analyzing possible simulation and game-based learning technologies, those engaged with curricular and program development would do well to keep an eye on what the design of the artifact conveys about the assumptions of the designers, and whether or not there is a good match between the tool and learning objectives. Specifically, educators can evaluate digital learning tools based on the degree to which the game or simulation guides the learner. They can accomplish this by setting up internally consistent goals in the learning experience that map effectively onto real practice. When appropriate, such tools should also seek to provide for the variance found in real practice. When evaluating a game or simulation for clinical training learning objectives, it is essential to ensure that the feedback cycles the tool engenders are meaningful, and triggered at appropriate times to advance understanding effectively.

THE ROLE OF OBJECTIVE-BASED CURRICULA IN THE DIGITAL ENVIRONMENT

For some, the excitement of embracing new technology can overshadow existing valid and meaningful curriculum objectives. For others, embracing any
change, let alone change that may require the acquisition of new skills and personal time investment related to the multimedia digital shift occurring in the clinical sciences is daunting if not intimidating. This said, occasionally, teaching institutions find self-proclaimed digital gurus and pioneers within their ranks. However, the key to leveraging the digital environment is to remember that good educational design principles start with objectives and theory. Designing curricula is much like designing a research project. All of the elements of the experiment or in this case curriculum must be present, including the course objectives. To extend the metaphor, the digital environment represents part of the methods section, but not the research question.

A common error that occurs during the introduction of digital tools involves forgetting the basic practice of aligning curricular content with learning objectives. This error also occurs when introducing game-based learning strategies into any curriculum and often results in the adoption of new technologies that may not align with or support the actual learning outcomes a program seeks to achieve. Failure to match technology to curriculum objectives or a haphazard adoption of technology-based resources without effective curricular integration and support can result in a combination of failures that may lead to a “Christmas tree” phenomenon (Bryk et al., 1998). This phenomenon can occur when a school or program continually adopts new conflicting educational technologies without effective integration, which in turn leads to a muddled learning experience. The adoption of learning technologies based on trends found in the current marketplace can lead to an accumulation of expensive unused resources. All of these issues can be effectively managed through an objective-based approach to developing a curriculum that leverages digital environments.

EXAMPLES AND CASE STUDIES OF GAME-BASED LEARNING

When recruiting digital tools for clinical education it is important to ensure that tool adoption (in this case games) is being driven by efforts to fill curricular holes, improve identified shortcomings, or generally improve the clinical experience so that students are better prepared for actual real-world practice environments. Teachers can see both successes and failures in this regard when adopting virtual worlds like Second Life into the clinical curriculum. Successes are marked by attempts to use these virtual worlds to rethink the failures of more traditional simulation technologies. Failures are evident in the array of now largely vacant training areas developed in these virtual worlds without consideration for how they will be used after their creation.

Various educational institutions have created virtual in-world environments within spaces like Second Life. However, few of those environments move beyond aesthetic appeal. By this we mean that the environments offer little more than a visually pleasing and accurate representation of an actual
space like a hospital or operating room. Due to an environment void of interaction and narrative, these spaces offer little if anything to promote curriculum objectives or translational facets of clinical education.

The New World Clinic is a Second Life island, created and operated by Gerald Stapleton from the University of Illinois at Chicago that moves beyond aesthetic appeal to promote specific curriculum objectives centered on patient communication and history-taking skills. Stapleton uses the New World Clinic as a virtual standardized patient laboratory. Students, through use of “avatars,” interact with other in-world “players” played by trained, standardized patients.

The SimQuest game Blast provides civilian and military care providers with an SB game targeted at training for effective scene and patient management following explosive blast incidents. The central objective of this game is to teach the concepts of triage. The game offers an aesthetically relevant environment, but more importantly it stresses patient and environmental fidelity. Players encounter nonplayer characters among the injured who have authentic physiology that is accurately mapped to injury and pathology. In this way, decisions that player/learners make in the environment drive outcome and consequence.

It is also worth noting that while many of the specialized digital resources designed for clinical programs can be costly, in some instances educators can repurpose less expensive tools developed outside of the clinical context or created under open source or open content licensing that may be available for nursing education. As with any other digital media, educators should accompany the media with an analysis of the specific learning objectives when adopting or repurposing existing tools. The analysis should include the specific learning objectives that the tool can help meet, as well as a thorough consideration of what additional costs or requirements accompany adoption of the tool in terms of curricular and technical support.

Game and simulation development can be very costly. Zero Hour: America’s Medic offers one example of how working collaboratively can minimize the infrastructural cost yet make good use of existing software development resources. This approach demonstrates how collaboration allows educators and content experts to focus on meaningful game content and game play to ensure that learning objectives are well mapped into the gaming experience. To develop Zero Hour: America’s Medic, a game-based environment for preparing EMTs/Paramedics for mass casualty events, the National Emergency Medical Services Preparedness Initiative at George Washington University and Virtual Heroes/ARA, the creators of the well-known military training and recruitment game America’s Army, collaborated. While creation of Zero Hour: America’s Medic required developers to create new content and new game resources, by working with an established vendor George Washington University was able to take advantage of Virtual Heroes/ARA experience with and ability to use the Unreal 3.0 game
engine. In addition, this partnership streamlined various aspects of the project including costly licensing considerations often associated with game platform choice.

The development landscape for creating games and simulations continues to evolve. As time goes on there will be a greater diversity of tools that enable game development to take place with less programming expertise. Adobe’s Dreamweaver software, and now various simplified content management systems have enabled huge numbers of users to develop websites without having a deep knowledge of HTML tags or similar programming software. Similarly, new tools now exist specifically for game development with less programming expertise on the part of the designer. The Unity software suite from Unity Technologies in San Francisco provides a particularly powerful example of a tool that allows developers and designers to create games and game-like tools with more moderate programming capacity, and at a substantially lower cost than that traditionally associated with licensing a game engine, such as Unreal 3.0. Similarly, Google’s App Inventor allows individuals with minimal technical expertise to develop simple applications for the Android operating system.

However, the availability of middleware tools like Unity or Google App Inventor does not guarantee the quality of the product (game or simulation) that developers can create. Dreamweaver made web design more accessible, but did not necessarily increase the quality of websites. Rather it ensured that more individuals with less training in graphic design and web-based technology could create websites. Similarly, as the availability of contemporary tools for game and simulation creation increases, the potential result may be the preponderance of products yielding poor learning experiences. Creating the sort of sophisticated representations of practice that can make a digital object into a powerful learning tool ultimately requires knowledge of how the system works that one is attempting to model. However, making such models into effective game-based learning tools also requires developers and educators to understand interaction design, have specific knowledge of what makes a simulation or game effective as a learning aid, and have an awareness of the role that the instructor will ultimately play in the virtual learning space. Further, one must come to accept that the requirements for making a successful learning game existing in a virtual environment, while similar to lab-based simulation experiences, are not identical.

**REUSE AND REPURPOSING**

Beyond the development of new digital tools, educators can glean examples of technology reuse or repurposing from other sorts of professional preparation programs. For instance, educational leadership professor Richard Halverson (University of Wisconsin–Madison) has done extensive work in developing
game and simulation-based learning solutions for in-service and preservice education leadership professionals. These efforts include Halverson’s adaptation of an early open-sourced version of the code for transcription software Transana. His purpose was to develop a simple tool for helping educational professionals develop an eye for evaluating classroom teaching and learning (Halverson & Wolfenstein, 2007). In addition, Halverson has repurposed the Microsoft PowerPoint presentation software as a means to engage students with case-based learning in a more meaningful manner (Halverson, Blakesley, & Figueiredo-Brown, 2011).

The latter example offers a particularly powerful example of developing a low-cost solution to a persistent educational problem: the propensity for learners to “arm-chair” the decision making process in case-based learning interactions, rather than confront the complexity that accompanies decision making in practice. By using PowerPoint, Halverson and his team were able to focus students’ attention on a new approach to case-based learning, rather than spending valuable instructional time introducing a new software tool.

Requiring nursing students to take part in the use of novel media or unfamiliar activities like game-based learning can be a challenge that often requires teachers to introduce and orient related technologies into the learning environment, whether students are undergraduates, new graduates, or advanced graduate-level learners who are used to traditional didactic instruction. For those instructors comfortable with the modern simulation lab, this is familiar territory. Orientating students so that they have an understanding of the possibilities and limitations of created environments is essential for learner success, whether they exist in virtual or physical spaces. Regardless of monetary cost, technology that is perceived as novel, new, or out of the ordinary is more likely to gain stakeholder consensus for integration into new and existing curricula when it is well understood by both teachers and students (Bauman, 2010).

Finally, educators can sometimes find powerful applications in off-the-shelf products developed for noneducational purposes. Professor Kurt Squire’s (University of Wisconsin–Madison) research on the use of Sid Meier’s Civilization III, a strategy-based video game based on and also steeped in contextually situated historical lessons stands out as a good example of how a professor effectively repurposed a product that was originally developed for entertainment purposes to teach a specific type of understanding within an educational domain (Squire, DeVane, & Durga, 2008; Squire 2011). While Squire’s work describes an example of repurposing game content related to general education, it is possible to imagine examples that could relate to nursing education. Many facets of nursing education focus on communication, prioritization, and critical decision making. Some refer to these as “soft” skills, but are more appropriately termed behavioral or nontechnical skills. While modeling these types of interactions is complex, there is a growing array of commercial games designed for entertainment purposes that seek to include some of these same critical elements as part of their successful game design.
(e.g., BioWare’s *Mass Effect* games). In addition, certain types of multiplayer games already on the market provide opportunities for players to develop these same critical skills through interaction with each other around collaborative objectives (Wolfenstein, 2010).

One thought-provoking and interesting example of entertainment-based gaming repurposed for use by the clinical sciences comes from the intersection of epidemiological research and the genre of Massively Multiplayer Online Games (MMOGs). In 2005, an unplanned event occurred in the MMOG *World of Warcraft* that provided an unparalleled research opportunity for epidemiologists to examine a population encountering an epidemic. Based on an exploit discovered by high-level players in the game, a virtual “virus” was unleashed on a large population of *player characters* in the game. Following up on a lead from her former student Eric Lofgren, epidemiologist Nina Fefferman took advantage of the opportunity to observe how the player population responded both to the virtual outbreak, and to the range of countermeasures that Blizzard, the creators of *World of Warcraft*, attempted to impose in an effort to curb the effects of the virtual epidemic (Lofgren & Fefferman, 2007). While this unplanned event presented a research rather than teaching opportunity, it provides a clear example of how a system designed for entertainment was capable of providing powerful insights with long-term implications for healthcare practices.

A somewhat more practical example of repurposing comes from studies that have looked at video games as tools to help enhance surgical training. A number of studies have focused on this topic, and a much larger range of research has been devoted to understanding whether, if any, psychomotor benefits games might have for the people that play them. In a literature review of studies looking specifically at surgical ability, Lynch, Aughwane, and Hammond (2010) determined that game players seem to acquire endoscopic techniques more quickly. While further research in this area is necessary to determine the efficacy of repurposing commercial games for clinical education, the examples provided here warrant the continued evaluation of commercially available entertainment games for eventual reuse for clinical education.

**SUMMARY**

When instructors implement tools or resources, like digital games and simulation existing in fixed or virtual-created environments, they have the capacity to fundamentally advance the quality and depth of the educational experiences an institution offers. However, implementing game-based learning tools and strategy requires careful thought to assure that instructors optimally align learning objectives with new technology. While we briefly discussed this earlier, it is worth emphasizing again. Without such efforts, at best the result is a series of learning technologies that receive only limited use by a handful of...
faculty who are comfortable with them and some of the students they teach. Outcomes can be substantially worse if an additive approach to technology accumulation fails to effectively integrate new tools for learning. This can lead to a graveyard of technology-based solutions gathering dust in a classroom or closet. Perhaps worst of all, without adequate integration and support, new tools can lead to a muddled curriculum that causes consternation for faculty as students attempt to reconcile their expectations for more traditional instruction with the reality of new tools to which they are unaccustomed.

The rising tide of digital resources has a powerful capacity to fundamentally transform and improve nursing and other forms of clinical education. However, early adopters who seek to stay on the cutting edge of clinical education would do well to ensure that they draw attention to both the power of digital media to advance clinical learning and the necessary and sufficient conditions that they must establish within a program to ensure that these new technologies are used effectively.

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