# Preface

As many have observed, the use of video game techniques and technologies for purposes other than purely entertainment has gained attention in recent years. So called serious games—those that have a non-entertainment purpose—are beginning to be developed in a variety of settings, including healthcare, education, and workplace learning. Despite the popularity of serious games, however, there are only now beginning to be rigorous attempts to guide application of the technologies, and evaluation of their ability to meet their intended goals. The purpose of this volume is to provide a cross section of the work being done in this burgeoning area.

The volume is organized around three themes: Design Principles for Serious Games, Applications of Serious Games, Games in Healthcare, The Way Ahead: A Roadmap for the Future of Serious Games. We should note that we did not necessarily intend to pull Healthcare out as a separate section, but we received so many quality chapter proposals in this area that we decided to group them together. This may be a function of the funding available to study health-related games (e.g., Robert Woods Johnson Foundation's Games for Health program) or attention being given to this area (e.g., the annual Games for Health Conference and Healthcare reform in general). In any case, much good work is taking place in this sector and will hopefully transfer over to other application areas.

The following sections describe the major themes of the book, along with a description of the chapters that fall within them.

## Section 1: Design Principles for Serious Games

This section provides several different perspectives on designing and developing serious games. Each chapter offers a design principle or strategy that can be employed to enhance the effectiveness of serious games. Several also include lessons learned drawn from specific serious game development efforts.

In the chapter entitled "*Mini-Games with Major Impacts*," Smith and Sanchez describe a strategy for developing mini games that can be embedded in game-based training. These authors address how mini-games can be used for conceptual or procedural knowledge and provide theoretical arguments from: Cognitive Learning Theory, Social Cognitive Theory, and Motivation. They also present descriptions of several case studies that used mini-games as part of the learning strategy. Smith & Sanchez conclude that mini-games have become sophisticated enough to be included in serious games.

McDaniel, Fiore, and Nicholson then discuss the importance of narrative in serious games in their chapter, "*Serious Storytelling: Narrative Considerations for Serious Games Researchers and Developers*." Specifically, they highlight the congruence between the game's story and its learning content as a mechanism to enhance the player's immersion in the game. These authors contend that narrative aids can help in game design in several ways, including: increasing the player's motivation to remain in the game, stories can embed learning objectives, and narrative can tie together elements in the game into

a coherent whole. They go on to cover selected narratological principles, interactive narratology, and then present a preliminary narrative taxonomy to guide research and development. They conclude with implications for the field.

In the chapter by Blasko-Drabik, Smoker, and Murphy, "*An Adventure in Usability: Discovering Usability Where it was not Expected*," these authors define usability as it is employed in software design. As with other software applications, it is important to establish the usability of a serious game to ensure that poor interface design does not interfere with learning. These authors describe the goals of usability and how it is traditionally performed using two popular methods. They go on to discuss appropriate usability measures for serious games. They compare two major methods and then conclude with a description of how usability analyses can be used to improve game design.

Next, Hussain and colleagues use a recent experience developing a serious game for U.S. Navy recruits to describe a multi-disciplinary approach to serious game design. In the chapter entitled, "*Development of Game-Based Training Systems: Lessons Learned in an Inter-Disciplinary Field in the Making*", these authors begin with a number of theoretical justifications for using games in learning, and then describe the process they employed in developing the serious game. Specifically, they describe their process in terms of the selection of training requirements, the domain and the gaming platform; knowledge acquisition; story development; game design; initial instructional design; assessment strategy; software development; introductory video; and review, refinement and testing. In each of the sections, they identify a number of tensions that need to be resolved as the game is being developed. They go on to provide lessons learned by describing how each of the tensions was resolved. These lessons learned can be of use to future serious game designers.

In the chapter entitled, "*DAU CardSim: Paper Prototyping an Acquisitions Card Game*", Metcalf, Raasch, and Graffeo describe development of a multiplayer card game that was first developed as a paper prototype. The game, a multiplayer scenario-based card game, was designed to teach skills associated with Department of Defense acquisition procedures and teamwork. The chapter provides a post-mortem of the iterative design process that included development of varying levels of simple prototypes for initial design and playtesting, followed by evaluation of game balance and refinement. They also cover the process they employed to digitize the game, and expand the game to cover additional learning objectives. Finally, they provide a series of lessons learned as they relate to paper prototyping as a design strategy.

The final chapter in this section, "*Kinesthetic Communication for Learning in Immersive Worlds*", by Ault, Warner-Ault, Wolz, and Nakra, posits a game design architecture that exploits the pedagogical potential of a rich graphical environment using a kinesthetic interface (such as the one used by the Nintendo Wii). They explain that their approach is grounded in the game's content so that genuine learning can occur in context. Furthermore, the kinesthetic interface is consistent with research showing that movement-based methods are more effective in language learning than more traditional methods. The authors conclude by describing directions for future testing and application of the kinesthetic input devices in serious games.

## Section 2: Applications of Serious Games

As noted, our conception of Serious Games is the use of games for any non-entertainment purpose, although the preponderance of attention has been given to educational or learning games. In this section, we have included several chapters that are not strictly educational in nature to highlight the fact that other applications are possible. That said, we believe that the potential application of games to learning (across settings and age groups) is vast and only beginning to be tapped.

To begin this section, Kelly provides compelling statistics showing that the quality of education in the U.S. is in dire need of improvement in his chapter, "*How Games and Simulations can Help Meet America's Challenges in Science Mathematics and Technology Education.*" Fortunately, he contends that modern technology has the potential to make learning more productive, more engaging, and more closely tailored to the interests and backgrounds of individual learners. According to Kelly, computer games provide a particularly good example of what can be achieved because they often require players to master complex skills to advance in the game. He goes on to address three key issues in educational game design: (1) designing the course of instruction so that it is both rigorously correct and constantly engaging, (2) ensuring that the system adapts to the background and interests of individual learners, and (3) evaluating the expertise of learners in ways that make sense to them and to future employers, using a game called "Immune Attack" as his example.

In the next chapter, "*Games for Peace: Empirical Investigations with PeaceMaker*," Gonzalez and Czlonka provide a example of using a video game to conduct empirical investigations designed to build theoretical models of socio- psychological variables that influence dynamic decision making. Specifically, they present an investigation on decision making in a dynamic and complex situation, the solution of international conflict and the achievement of peace, using PeaceMaker, a popular video game. PeaceMaker represents the historical conditions of the Israeli-Palestinian conflict and provides players with an opportunity to resolve the conflict. Students in an Arab-Israeli history course played perspectives of the Israeli and Palestinian leaders at the beginning and end of the semester. Student actions were recorded and analyzed along with information about their personality, religious, political affiliation, trust attitude, and number of gaming hours per week. The authors offer several conclusions regarding the manner in which these variables affect conflict resolution, hence the game served as a mechanism to better understand the phenomenon of interest. Many other applications of this approach to sutdy human behavior in complex systems seem obvious.

Nadin begins the next chapter, "*Play's the Thing: A Wager on Healthy Aging*," with the hypothesis that the aging process results in diminished adaptive abilities resulting from decreased anticipatory performance. To mitigate the consequences of reduced anticipatory performance, he addresses brain plasticity through game play. Since anticipation is expressed in action, the games conceived, designed, and produced for triggering brain plasticity need to engage the sensory, cognitive, and motoric aspects of performance. Nadin offers a rich theoretical foundation upon which to design and validate such games.

A popular notion among those developing serious games is that entertainment games can be repurposed to accomplish serious objectives. In their chapter, "*Re-Purposing a Recreational Video Game as a Serious Game for Second Language Acquisition*," Rankin and Shute describe efforts to re-purpose the recreational Massively Multiplayer Online Role Playing Game (MMORPG) EverQuest® II as a serious game to promote learning in the context of Second Language Acquisition (SLA). They outline the process of game transformation, which leverages the entertainment value and readily accessible developer tools of the game. They identify the affordances attributed to MMORPGs and then evaluate the impact of gameplay experiences on SLA. Promising results are described.

## Section 3: Games in Healthcare

Given the number of high quality proposals we received in the healthcare area, we decided to create a separate section to highlight this important area. The chapters in this section offer a sampling of the types of Serious Games being developed in this area. These include: games being used in the therapeutic process, games to promote healthy behaviors, games to train healthcare professionals, and pervasive health games. These applications, as well as others related to healthcare, have the potential to play an important role in the future of healthcare in the U.S. and across the world.

In the introductory chapter in this section, "*Application of Behavioral Theory in Computer Game Design for Health Behavior Change*," Shegog provides an excellent overview of behavioral theories and how they might be used to promote health behaviors. The chapter introduces serious game developers to processes, theories, and models that are crucial to the development of interventions to change health behavior, and describes how these might be applied by the serious games community. Shegog goes on to describe the protocols, theories, and models that have informed the development of interventions in health behavior change and reviews them in terms of their potential contribution to serious game design, implementation, and evaluation. The author describes a serious game application aimed at cognitive-based gaming in adolescents to exemplify this.

Next, McDonald asserts that virtual-world technologies have advanced to the point where they can be considered as a viable method for delivering medical curricula effectively and safely. In her chapter entitled "*Avatars and Diagnosis: Delivering Medical Curricula in Virtual Space*," she contends further that research must establish that such systems are reliable and valid tools for delivering medical curricula; otherwise, they are of no use to the medical community, regardless of their technical sophistication. McDonald then describes Pulse!! The Virtual Clinical Learning Lab—a project designed to explore these issues by developing a reliable and valid learning platform for delivering medical curricula in virtual space. She uses the Pulse!! example to describe lessons learned in the general area of collaboration, including issues such as funding, technology and evaluation. She concludes with a discussion of what lies ahead for the Pulse!! research and development project.

In the chapter by Andrews, Joyce, and Bowers, called "*Using Serious Games for Mental Health Education*," these authors address the mental health training and education needs of modern "at risk" populations and discuss the potential of serious games as effective interventions for addressing those needs. These authors pay particular attention to the importance of prevention training and ways in which serious games can be designed to facilitate the prevention process. They focus specifically on interventions targeted at the development of appropriate coping skills associated with certain sets of mental health risks. Within the chapter, the authors describe several specific mental health-related serious game efforts and discuss design considerations for effective serious games.

Knöll then discusses the potentials of serious game applications in a health context to improve user's motivation, education, and therapy compliance. He focuses on "*Pervasive Health Games*," which combine pervasive computing technologies with serious game design strategies. They represent a new instantiation of gameplay essentially using the user's environment as the play space, and therefore extending into their everyday life. Knöll presents the new typology of PHG as an interdisciplinary field, consisting of health care, psychology, game design, sports science, and urban research. A brief introduction to the theme is illustrated with a conceptual "showcase," a pervasive game for young diabetics.

Capitalizing on the trend toward developing games for physical activity (so called, "exergaming"), Johnston, Sheldon, and Massey describe a game designed to influence physical activity and wellness in the college-age population. In their chapter entitled "*Influencing Physical Activity and Healthy Behaviors in College Students: Lessons from an Alternate Reality Game*," these authors describe how they were motivated to develop the game based on statistics showing that in the transition to college individual demonstrate an alarming decrease in physical activity. Simultaneously, a significant weight gain during early college years has been shown to increase the risk of obesity and associated diseases later in life such as diabetes and coronary heart disease. In this study, the authors investigated the effectiveness of a prototype Alternate Reality Game (ARG) – called *The Skeleton Chase* – in influencing physical activity and wellness of college-age students. A growing game genre, an ARG is an interactive narrative that uses the real world as a platform, often involving multiple media (e.g., game-related web sites, game-related blogs, public web sites, search engines, text/voice messages, video, etc.) to reveal a story. They provide preliminary findings on the effectiveness of the game as well as lesson learned to guide future efforts.

## Section 4: The Way Ahead: A Roadmap for the Future of Serious Games

In the final section, we included chapters that focus on looking toward the future of serious games.

First, in the chapter entitled "*Establishing a Science of Game Based Learning*," Sanchez, Cannon-Bowers, and Bowers offer a simple framework for organizing variables important in the learning process and then discuss findings from psychology and education as a basis to formulate a research agenda for game-based training. These include: characteristics of the user, pedagogical features embedded in the game, and game design features. These can all affect the user's motivation to interact with the game, and in turn, influence learning, while some of the features may also exert a direct impact on learning. The authors' purpose in presenting this framework is to stimulate researchers to conduct systematic, appropriately controlled experiments that will provide insight into how various game features affect motivation and learning. According to these authors, by following theoretically-based roadmap, a true science of educational games can be formed.

In the final chapter, "*The Way Ahead in Serious Games*," Cannon-Bowers attempts to summarize some of the major themes found throughout the volume. She offers some observations and presents suggestions for the way ahead in serious games and their application to important societal challenges.

Overall, we are moved to comment that serious games hold great promise as a means to reach and affect large numbers of people in a positive way. Capitalizing on the popularity of video games, along with emerging digital technologies and more accessible delivery methods, those seeking to affect positive change in the future may find that serious games are a useful mechanism to both study and influence human behavior. We believe that efforts to investigate serious games and their impact in scientifically valid and rigorous ways must continue if this potential is to be reached.

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