Preface

Games and simulations are growing entertainment and cultural forces in our world. Players embrace games and simulations on game machines, PCs, mobile phones and online; they develop quick-reaction and motor skills, engage cognitive processes, enter into complex fantasy environments, play with peers across the planet, and even create entire new social lives in simulated environments. Meanwhile, educators struggle ever-harder to engage their students who are more drawn to these attractive new activities than to more traditional learning. Using games and simulations as learning tools could help, but how can we conceptualize, design, and implement them effectively?

*Educational Gameplay and Simulation Environments: Case Studies and Lessons Learned* presents a collection of papers based on research arising from Canada’s *Simulation and Advanced Gaming Environments (SAGE) for Learning* Project (2003-2008). Covering theoretical, social, and practical issues related to educational games and simulations, these chapters contribute to a strong foundation, clearer understanding, and more effective design and implementation of these activities in learning environments. This volume should both help and challenge educators, researchers, and game developers wishing to broaden their work to effectively include games and simulations.

**THE SAGE FOR LEARNING PROJECT**

Aimed at better understanding and supporting learning in these environments, the bilingual, Pan-Canadian *SAGE for Learning* initiative addressed the interplay among the exploding popularity of technology-based simulations and games for entertainment; new technologies for appealing, immersive, engaging simulations and games; and growing evidence that learning works best when people collaborate, practice and reflect on their learning.

Focusing on health-related learning, the initiative investigated:

- how people learn through technology-based simulations and games
- which cognitive, human and social factors, as well as which game and simulation characteristics, contribute to making simulations and games engaging, motivating, and effective for learning
- how to integrate new technologies and our theoretical knowledge of learning to create effective learning simulations and games in real-world settings (e.g., schools, hospitals, businesses, communities)
- how to improve our methods and tools for research and evaluation on learning with simulations and games
The project was funded for approximately $3 million by Canada’s Social Sciences and Humanities Research Council (SSHRC) through its Initiative on the New Economy - Collaborative Research Initiative Program. Thirty-six Canadian and international university-based researchers in education, psychology, computer science, educational technology, new digital media, and research/evaluation methodologies participated. The project also included over thirty Canadian and international partner organizations, many of which supported and collaborated on SAGE research projects.

SAGE for Learning members worked to transform health-related learning through the study, development, and application of technology-based games and simulations. The network’s research objectives were to:

• build and validate a common multidimensional taxonomy and conceptual framework to guide SAGE research
• describe the types and characteristics of learning that take place through the use of SAGEs
• identify, observe, document and model key cognitive and social processes that develop, promote or hinder learning in SAGEs
• study the capacity of SAGEs to support learning as described by key learning theories through adaptation and creation of simulations and games for specific learner groups and tasks
• develop and implement research methodologies and tools appropriate for describing and assessing SAGE learning processes and outcomes
• demonstrate the application of knowledge resulting from our research on SAGE impacts in the development, implementation, and testing of prototype SAGEs
• pilot the implementation of SAGEs in authentic contexts, e.g. schools, businesses, and community settings

These research objectives were addressed through a multi-methodological approach consisting of descriptive, developmental, and evaluative research phases, using a mixed quantitative-qualitative methodology. SAGE research was conceptually grouped into foundation and application domains, with specific loosely integrated projects addressing theoretical as well as practical issues involved in translating game and simulation entertainment technologies into effective learning tools and in evaluating their learning impact.

NEW-GENERATION LEARNING

Understanding games and simulations for learning is important because we face major questions about how our technology-supported education approaches should evolve. As noted above, simulations and games are now significant entertainment vehicles. The statistics are staggering: global video game sales are expected to reach 68.3 billion by 2012, approximately 65% of American households play video games, and 63% of parents believe that games are a positive part of their children’s lives. Massively Multiplayer Online Games attract millions of players; for example, 11.5 million were playing World of Warcraft® in late 2008, and the Second Life® virtual environment, which includes virtual college classrooms, is said to have more than 1.5 million registered users.

As they have become more widely accepted, games and simulations have emerged as tools for learning outside and within academia; educators and trainers reason that the popularity, engagement characteristics, and wide accessibility of digital games and simulations can provide powerful learning tools if
understood and properly exploited, particularly for newer generations of learners. Several writers have suggested that the “gamer generation” has developed a new cognitive style characterized by multitasking, a relatively short attention span, and a preference for learning through investigation and discovery, all characteristics of game-based learning. Others believe that, inspired by a constructivist approach, the use of video games has changed young people’s way of learning: the learner plays first, then learns and later generalizes to apply experiences in new situations, while the teacher’s role has changed to supporting active learning and the construction of knowledge. Some writers describe the profile of current teenagers as “born communicators” who prefer their learning to be interactive, visual, kinesthetic, immediate, and involve “doing” rather than thinking or talking. Finally, some believe that online games offer the “digital native” generation the opportunity for inductive reasoning, allowing players to resolve cognitive conflicts through a constant cycle of hypotheses, test and revision.

Games and simulations, often embodying established learning theories, should be excellent learning tools. Their exploration, collaboration, complex problem solving, practice and feedback through “safe” failure and learner decision-making, have led to claims that they can support constructivist learning, situated cognition, cognitive apprenticeship, experiential learning, development of self-efficacy and learner-centeredness. However, educational institutions have not yet deeply investigated their potential, and much research remains to be done to establish effective ways to design, develop and integrate them into educational settings.

IN THIS VOLUME

Educational Gameplay and Simulation Environments: Case Studies and Lessons Learned addresses this need in a diverse collection of papers arising from individual SAGE research projects, linked by their common concern with effective learning-related theory and applications for games and simulations. This volume covers specific issues and examples in theoretical foundations, design, prototyping, application, and evaluation, complemented by a detailed look at the planning, design, development and validation of a specific online generic educational game shell and game application.

Section 1: Foundations and Theory

The recent rush to study and apply games and simulations to learning has produced studies with varying conceptual frameworks and methodologies. As a result, their results are often conflicting or inconclusive, limiting their value. Section 1 is intended to help clarify the theory and fundamental concepts of the field and to support educators and learners in understanding these fundamentals.

Games, Simulations and Simulation Games for Learning: Definitions and Distinctions (Chapter 1), presents the results of a systematic review of the literature from 1998 through 2008 to develop a conceptual definition of games, simulation and simulation games based on their essential attributes. The authors describe their motivation for the analysis, their methodological approach, databases reviewed, analysis grid and the results of the review, differentiating among the three categories. This analysis is intended to improve the precision of future studies concerning the effects of games, simulations and simulation games on learning by contributing to a common language for current and future research.

Chapter 2, Effective Educational Games, argues that educational games have not always been taken seriously but are, in fact, highly interactive (and playful) supports for communication and interaction that should be employed more fully in 21st century education. The chapter summarizes studies highlight-
ing mechanisms that motivate and support learning, including competition, challenge, feedback, active learner participation, teamwork, interaction, repetition and segmentation of learning content. These are illustrated with examples of health-related game applications. This work should reduce educators’ concern about using games and simulations for learning by clearly describing their demonstrated benefits and providing supporting evidence and examples.

Simulation in Health Professional Education (Chapter 3), provides background and orientation for the use of simulations in health-related learning. It defines “simulations” and outlines their attributes, goals, advantages and limitations, suggesting ways of overcoming the latter. After distinguishing and illustrating categories and forms of simulations and explaining elements that make simulations effective, the chapter examines the contributions of various types of simulations to the training of health professionals and briefly describes examples developed within the framework of the SAGE project.

The next two chapters in Section 1 discuss how specific game or simulation elements influence learning. Chapter 4, The Role of Narrative in Educational Games and Simulations, discusses the major role which narrative components play in supporting learning in interactive games and simulations. Applied correctly, these components have the capacity to improve the interactive experience and to support learning that is rich in significance.

Chapter 5, Does Fantasy Enhance Learning in Digital Games? examines how digital games have the potential to create environments that increase motivation, engage learners, and support learning. The authors explore the relationship between digital games, imagination and learning, and describe key factors which make digital games motivating. They argue that these factors are important in the design of games for learning because motivation plays a major role in engaging players in learning activities. They then describe the contribution of fantasy in the context of digital games and the importance of creating types of fantasy adapted to different sexes. Finally, they examine how learning content is integrated into fantasy-based digital games.

In Chapter 6, Gender and Digital Gameplay: Theories, Oversights, Accidents, and Surprises, the authors criticize and challenge game studies researchers, arguing that faulty assumptions and biases have distorted research in game studies. They identify norms and assumptions that lead to difficulties and briefly present a three-year study on gender and digital games, explaining more precisely the effects of some of these too-frequent “traps.” Their work should help to expand our research vision, improve study design, and increase our understanding of girls and gameplay.

Chapter 7, Games in Health Education: A Survey of Pre-service Teachers, presents background data on the need for effective health education in the schools and describes a field study evaluating student teachers’ perceptions of the use of games for health-related learning. This survey, carried out with 300 pre-service teachers in New Brunswick and Quebec, studied respondent familiarity with games, their perceptions of the utility of games for learning, and the games they preferred to play. The results of this study informed a specific educational game project and, more generally, provide us with insights into the gap between “desire” and “practice” in the use of educational games.

Chapter 8, Video Games and the Challenge of Engaging the “Net” Generation, changes perspective to discuss the use of videogames in education from the viewpoint of a professional game developer. Noting that educational games are often criticized for stressing learning to the detriment of their playful, engaging aspects, the author describes for educators the aspects of modern personal computer games that create and retain player interest. He argues in favor of more communication and cooperation between education specialists and commercial game developers to improve the quality and learning impact of their digital games.
Section 2: Design and Prototyping

Section 2 presents research and application software prototypes for educational games, simulations, and simulation games, as well as tools to support their delivery and evaluation. These chapters expand our understanding of good design and the game/simulation creation process. They also broaden our knowledge of the potential for games and simulations to support learning in new ways and content domains.

*Educational Games: Moving from Theory to Practice* (Chapter 9) presents a creative process for the game *Contagion* in which, in contrast to traditional approaches, players are involved in all stages of game creation; avoiding a formal framework of “learning outcomes” for the game, the authors instead worked to embed useful knowledge from a teaching point of view in all aspects of game design and play. This chapter challenges our beliefs about simulation game development.

Chapter 10, *Designing a Simulator for Teaching Ethical Decision-Making*, presents the design of a multimedia simulation-based learning environment the *Ethical Advisor*, which support the scenario-based teaching of ethical decision-making. The case-based environment challenges learners to identify relevant information, to analyze decisions in light of theoretical models, and to manage and filter information flow.

In Chapter 11, *Design of a Socioconstructivist Game for the Classroom: Theoretical and Empirical Considerations*, the authors describe the use of literature reviews, a field study, and an analysis of multimedia educational games to develop theoretical and empirical foundations for the design of new types of educational multi-media games that support the socio-constructivist approach recommended in new primary and secondary school curricula. The study results informed a comprehensive set of requirements guiding the choice of a game framework.

*Online Multiplayer Games: A Powerful Tool for Learning Communication and Teamwork* (Chapter 12) describes the design of a communication and groupware platform, *ENJEUX-S*, that increases the learning impact of online games and simulations by allowing gameplay with integrated video and voice real-time communication. The learning contributions of the platform are emphasized, showing the learning advantages of online, multimedia, multiplayer games. The *ENJEUX-S* testing methodology and results offer an example for developers of online environments.

*Advancing the Study of Educational Gaming: A New Tool for Researchers* (Chapter 13) describes *OpenVULab*, an Internet-based system supporting flexible, remote data collection and analysis for the formative and summative evaluation of online games and simulations. An initial field trial of the tool is presented, providing a useful approach for similar studies and a clear illustration of *OpenVULab’s* research and practical value.

Chapter 14, *Designing Socially Expressive Character Agents to Facilitate Learning*, moves farther into the future with a description of *FaceSpace*, an expressive but easy-to-author 3D character-based system that makes possible simulated face-to-face collaboration, adaptive socially-based presentations for informal learning, and multi-user, avatar-based distance education scenarios.

In a specific health domain, *The Use of Virtual Reality in Clinical Psychology Research: Focusing on Approach and Avoidance Behaviors* (Chapter 15) described how simulations using immersive virtual reality technologies, combined with the analysis of recorded ocular and physical movements, can help to improve our understanding and treatment of psychopathologies. Experiments treating phobias and pedophilia show how this simulation-based learning approach might be applied in practice.
Section 3: Learning Efficacy

Section 3 acknowledging the need for clear evidence to support claims about the effects of games and simulations on learning, focuses on literature and evaluation studies that demonstrate or question their learning impact. Chapter 16, *The Efficacy of Games and Simulations for Learning*, reviews the game and simulation literature (1998-2008) on learning effectiveness, drawing on the foundational work presented in Chapter 1 to base the review on clear game and simulation definitions. Concentrating on knowledge structuring and the development of problem-solving skills, the chapter is a major contribution to arguments for the use of games and simulations as tools for complex learning.

*Collaborative Online Multimedia Problem–Based Simulations (COMPS)* (Chapter 17) describes an innovative online problem-based learning application that incorporates multimedia elements and a video narrative into a medical case. The results of a preliminary evaluation show that this approach is effective in developing critical reasoning skills.

Chapter 18, *Games for Children with Long-Term Health Problems*, describes the development and testing of a game framework and series of handheld and PC-based videogames for children in with chronic health problems. Their results show great promise in using videogames for these types of applications.

An unusual study examining learning effects of a virtual dog simulation is presented in Chapter 19, *Handheld Games: Can Virtual Pets Make a Difference?* The study examined whether children’s’ empathy toward animals, and attitudes toward the humane treatment of animals, could be improved through using a handheld videogame that allows them to play with and care for a virtual dog. Results support the use of gameplay to develop and enhance children’s caring attitudes and behavior.

Chapter 20, *The Learning Impact of Violent Video Games*, attempts to answer queries posed by parents to the SAGE project about whether they should be concerned about violence in games played by their children. Through a review of current literature on the topic, the authors address the issue of violence in videogames and summarize evidence for and against its harmful effects. Although research to date has not produced a clear conclusion, the chapter should contribute to our understanding of the concepts, controversies, practical research issues, and conflicting evidence surrounding this question.

Chapter 21, *A Study of Biofeedback in a Gaming Environment*, reports on an innovative study conducted in a neuro-educational laboratory that examines the issue of learning biofeedback through a videogame. This exploratory work lays a path for further work that could eventually lead to innovative methods of learning enhancement, as well as treatment for problems such as learning anxiety.

Section 4: Special In–Depth Section on Game Shell and Game Creation

Section 4 is a special section that outlines the development process used by a research team at the research center SAVIE (*Société d’apprentissage à vie* – www.savie.qc.ca) at the Télé-université in Quebec, Canada, to develop a generic educational game shell (GEGS) for a series of online educational frame-games for their Educational Games Central online community (http://egc.savie.ca). The section’s five chapters describe the analysis, design, interface specification, and validation of the GEGS and the formative evaluation of a specific game created with the shell. Section 4 differs from others in this volume in that it illustrates the practical process of creating a GEGS, using the game *Parcheesi* as a framework. Taken together, the chapters in Section 4 provide the reader with a comprehensive “how-to” picture of one educational game project, complete with detailed steps, design criteria, explanations for the choices made, and validation guidelines and results.
CONCLUSION

This collection should be useful in many ways to researchers, practitioners and students of games and simulations for learning. For researchers, it adds to the theoretical and practical knowledge of game- and simulation-based learning and suggests many directions for future work. For educators hoping to use games and simulations, it provides helpful examples, guidelines, evaluation techniques and results, and lessons learned. For education and learning technology students, this collection provides foundation knowledge, identifies key questions and implementation considerations, and should stimulate further discussion and curiosity. For game developers, it provides theoretical background for design choices; resources to support design, development, and evaluation; and extensive examples and guidelines to apply in practice.

It is our hope that all readers will be encouraged to consider more deeply the relationships among games and simulations, learning theory, and practice, ultimately advancing their skill in creating and implementing effective and engaging environments for today’s and tomorrow’s learners.

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