

# Lessons Learned from Games for Education

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## Abstract

This panel brings together researchers on games and their effects on learning, to discuss what is known and identify outstanding research questions. They draw on their own experiences in creating educational games, putting them into practice, and observing their effects on learning.

**Keywords:** Computer games, serious games, education, experiential learning environments

**CCS:** K.3.1, Computer uses in education; I.6.8, types of simulation

## Overview

There is growing interest in the use of games to facilitate learning. Researchers such as Gee [2003] and Prensky [2001] have argued that good games engage learners in a manner that promotes learning, and in fact many commercial games are designed in such a way to promote learning. This learning takes place both during the game, as users develop their game skills, and outside of the game, as they reflect on how they might play better, seek tips and resources about game play. They collaborate and share tips with other gamers, often forming on-line communities.

Game design techniques can also be applied to software with educational objectives, yielding so-called serious games, games with educational value as well as entertainment value. Like games with purely entertainment purposes, such games should engage learners deeply, to motivate them to persist in playing and develop their skills so that they can play at progressively higher levels of expertise. They should be fun—learners should derive pleasure from playing them, even as they exert effort to perform better. Furthermore, the goal of such games is to engage learners not just in the game, but in the subject matter itself. It is hoped that the game experience will motivate learners to study the subject matter more deeply, seek out information relating to the game, and engage in on-line collaboration, just as with entertainment games. Finally, it is hoped that the learning benefits of such games will transfer to the real world—that learners will be able to apply knowledge that they have gained to problems outside of the game.

Yet in spite of this interest in games for education, we are just beginning understand when and how games promote learning, and why. One reason for this is that the concept of just what constitutes an educational game is changing. Until a few years ago, games were conceived narrowly as rule-governed competit-

ive experiences involving keeping score [Lucassen, 1996]. Although many games continue to adhere to this model, many do not. Nowadays we find new game genres in which a narrative structure guides the gameplay instead of simply scorekeeping, and games in which there is no winning or losing. Simulations, once considered separate from games, are now often an intrinsic part of the game. So as the nature of games has expanded and changed, past research on educational games may no longer apply to current games.

Even when games are found to be effective in promoting learning, it is often difficult to determine the precise cause. Games employ a number of design techniques to maximize the user's game experience, and teasing out their contributions can be difficult. However experience suggests that features of games that contribute to learning effectiveness are not necessarily the superficial ones such as the photorealism of the computer graphics. Rather, it is the quality of the interactive gameplay that is most important. That is not to say that graphical rendering is irrelevant for effective serious games, but rather the role of graphics is subtler than might first appear, e.g., it helps to provide learners with immediate feedback on their actions and affordances that guide gameplay.

This panel will investigate these issues, by bringing together researchers who are actively engaged in applying games and game design techniques to educational problems. The panelists are all members of committee established by the Computing Research Association and the National Science Foundation in 2004 to help set the NSF's agenda for research in games and education. An addition to the participating panelists, other members of the NSF committee have volunteered to attend the session and help seed audience participation.

The panelists will try to clarify what is known about games and their effects on learning, and what outstanding research questions remain. They will draw on their own experiences in creating educational games, putting them into practice, and observing their effects on learning. The following are some of the questions that the panelists will address:

- What features of games are most important for promoting learning?
- How do non-game learning activities and learning aids change when game-based activities are introduced? How can they best be integrated?
- How does game-based learning transfer to the real world?

## The Panelists

**W. Lewis Johnson** is the director of the Center for Advanced Research in Technology for Education (CARTE) at the University of Southern California. USC has a broad range of research and educational activities relating to games. Prof. Johnson leads the Tactical Language Training Project, which is developing interactive games that help people learn foreign language and culture. The project combines advanced

technologies in artificial intelligence, intelligent tutoring systems, and speech recognition, with game design techniques and game engine technologies. Tactical Iraqi, a course developed for spoken Iraqi Arabic, is currently being beta tested at a number of military installations around the world. A paper describing this project [Johnson et al. 2004] was selected as Best Paper in the Training category at IITSEC last year. The project has made a strong commitment to evaluation, yielding evaluation results that not only provide evidence of learning effectiveness but also provide insight into the relative contributions of different game elements. Dr. Johnson is also a leading researcher in the area of animated pedagogical agents and their effects on learning in a range of different application areas and platforms.

**Dr. Idit Caperton** is the head of MaMaMedia, Inc., developer of a major educational game site on the Web. She has developed new tools and experiences that can open a new chapter in interactive children's education, intellectual expression, and play.

**Dr. Carrie Heeter** is Professor of Telecommunication, Information Studies, and Media, Creative Director for Virtual University Design and Technology, and Director of the Communication Technology Laboratory at Michigan State University (MSU) where she conducts research on technology-enhanced learning, games for learning, and games for girls. Her game-related work includes adapting and extending the genre of "casual" (easy to and relatively fast play) games for learning. Casual games are particularly suited to informal science learning, to use in the classroom and at home, and are a game genre played more by women and girls than most other electronic commercial games.

Heeter has developed and studied interactive learning experiences since 1989 when her lab created the first educational CD-ROM (Mission to Mars). Her 1995 product, the Personal Communicator, incorporated digital video to enhance communication between deaf and hearing children. It won Discover Magazine's award for software innovation of the year. The derivative web site, the ASL Browser, serves more than 9,000,000 pages per year. Heeter is currently PI for two NSF-funded projects. The first, Girls As Designers, is nearly complete and uses qualitative and quantitative methods to test the hypothesis that games designed by girls will be measurably different than games designed by boys and will appeal more to girls. Her team is also developing a learning game (Tree of Life Critter Capture) designed to explore structural elements of a casual learning game and to test the hypothesis that girls will learn more from a learning game than boys will, based on gender differences in game play style found in prior research.

**Yasmin B. Kafai** is an associate professor at the UCLA Graduate School of Education & Information Studies where she leads a research group developing and studying media-rich programming and learning environments. She will report on a current NSF-funded study that investigates the educational potential of immersive participatory simulations in an large-scale online community called Whyville. Whyville provides open access to about 550,000 registered users in the ages 7-15 and has about 14,000 daily users. Users log onto the site after school and on holidays in order to engage in a wide range of activities including science investigations, chatting, arranging face parts for their avatars and building virtual homes.

The evaluation focuses on how the participation in a communicable disease called Whytox, which involves the whole community of Whyville over several weeks, will affect students' science understanding. The Whytox infection revealed itself in two forms: the appearance of red dots on the players' avatars in Whyville and sneezing disrupts during the chat mode that replaced typed conversations – two key aspects of Whyville community life. The findings from this research will provide insights on how to design participation for learning in multi-player online environments.

**Dr. Brian M. Slator** is a Professor of Computer Science at North Dakota State University (NDSU) where he conducts research on learning using immersive virtual environments. These are 'desktop' VR systems that employ a role-based metaphor where learners are invited to explore a spatially oriented simulated world – completing tasks, achieving goals, and practicing the skills needed to solve the problems embedded in the simulation. These simulations support multiple simultaneous users, which creates a learning community and raises questions about how students learn roles in that culture, and how to best manage and support cooperation and collaboration among them. In many cases these questions are addressed with software agents that provide a range of services from the practical to the pedagogical.

Since the early 1990s, Dr. Slator, along with colleagues, content experts, and students, has directed the design and implementation of a number of such virtual environments for learning in differing disciplines: geology, biology, archeology, computer science, and micro-economics, among others. He is first author on a paper [Slator et al. 1999] given an outstanding paper award at ED-Media-99, has appeared as panelist on a PBS satellite broadcast forum on "Exemplary Models for Web-based Learning", won the Ernest L. Boyer International Award for Excellence in Teaching, Learning and Technology at the International Conference on College Teaching and Learning, April, 2000, and the NDSU Peltier Award for Innovation in Instruction, May 2004. His leadership role in the NDSU research team has led to several million dollars in research funding from the National Science Foundation and the U.S. Department of Education.

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