Moving into Cyberspace

Game Worlds for Learning

Margaret Corbit
corbitm@tc.cornell.edu

***Margaret Corbit** is Research Outreach Manager at the Cornell Theory Center (CTC) and Director of CTC's online science museum <www.SciCentr.org>.*

It has been well-documented, especially by marketers, that the Internet and computer games are part of the life experience of a generation of students referred to as Generation Y, the Millennials, or the Echo Boomers. While many educators equate time spent playing computer games with wasted energy and violent behavior, this might not be the case. In fact, the variety of games is expanding, and such open-ended, online games as *The Sims* have added new social and ethical dimensions to computer game play. And now we talk of Neomillennials working and learning *within* cyberspace.

GenerationM: Media in the Lives of 8–18 Year-Olds, a recent report from the Henry J. Kaiser Family Foundation (2005), identifies positive associations between the number of hours spent online or playing games with the number of hours spent with parents, doing physical activities, and pursuing other hobbies. According to the National Learning Infrastructure Initiative of EDUCAUSE, a nonprofit association that promotes the intelligent use of information technology in higher education, "games represent active, immersive learning environments where users integrate information to solve a problem. Learning in this manner incorporates discovery, analysis, interpretation, and performance as well as physical and mental activity" (EDUCAUSE 2005). And there is a growing knowledge base grounded in research that suggests that computer game technology and related media can and should be adapted for constructive educational uses.

With the advent of multiuser online games (*The Sims Online, Everquest,* and others in the commercial arena), the immersive environment of the computer game gains a social context. In this we see a convergence of collaborative environments and desktop computer games into the medium of virtual worlds (also known as multiuser virtual environments, or MUVEs; collaborative virtual environments, or CVEs; and by a number of other descriptive terms). For at least ten years, computer scientists, cognitive scientists, educators, and artists as explorers and early adopters have been researching and publishing on the constructive use of virtual worlds for education, training, and communication. VLearn3D.org <www.vlearn3d.org>, a special interest group of the Contact Consortium, supported a community of educators and designers sharing insights and experiences through annual conferences within the worlds themselves from 1998 to 2002. The MIT Games-to-Teach initiative <www.educationarcade.org/gtt> led by Henry Jenkins and Microsoft's Randy Hinrichs spawned a generation of young researchers feeding into what is now the Serious Games Initiative.

Virtual worlds are being incorporated into both formal and informal education programs. Ongoing, large-scale research and development projects in the K–12 arena include Sasha Barab's *Quest Atlantis* <http://inkido.indiana.edu/atlantis> elementary-level program at Indiana University and Chris Dede's *River City* (see article on page 29–32) middle school science curriculum at Harvard's Graduate

School of Education. SciCentr, the online outreach program at Cornell Theory Center (CTC), now reaches more than one thousand teens each year with innovative Science, Technology, Engineering, and Mathematics (STEM) outreach programs conducted in its universe of virtual worlds, CTCUni. In addition, the five-year Borderlink Project <www.borderlink.org> in southern California demonstrated the use of virtual worlds in its effort to "remove barriers to post-secondary education opportunities for students in remote, small, rural, and isolated schools through the use of innovative technologies" (Kerney 2005).

Each of the above programs is based technically on the Active Worlds <www.activeworlds.com> proprietary software system. This system provides researchers, and, in the cases of SciCentr and Borderlink, designers, and teens, many features of commercial games in an open, modular infrastructure. Virtual worlds and their interactive game features developed for Active Worlds can be optimized to work within the constraints of public school classrooms and computer labs and can be revised with relative ease.

Cornell's SciCentr and SciFair

In a recent issue of *EQ* (*EDUCAUSE Quarterly*), Dede (2005) identifies the next generation of students as the Neomillennials. Born after 1995 and now in K–12 classrooms, these are the people who will inhabit cyberspace. He describes an opportunity for enhancing their educational experience through "active construction of knowledge through mediated immersion" (11). This is precisely the approach applied to our development of SciCentr programs. All participants immerse themselves in the 3D virtual worlds and explore, interact with, and build new content within this social setting. Student activities are mediated through three interrelated elements: the design of the world within which they play and work, the infrastructure which supports their own creation of worlds, and their interaction with trained coaches and mentors.

CTC is the high-performance computing center at Cornell University, supporting interdisciplinary research and computational science. Having moved its outreach efforts onto the Web in 1995, CTC outreach looks for new ways to use computers to engage people in lifelong learning, and its efforts are now focused under the umbrella of Scicentr.org <www.scicentr.org/scicentr/presentations/index.html>. In 1998 SciCentr began to envision a science museum without bricks and mortar. SciCentr now focuses its activities in CTCUni, a universe comprised of both virtual museum exhibits and worlds created by teens in a variety of science and technology outreach settings using the SciFair Model. In 2004, more than one thousand students and teachers in Washington, California, Virginia, and New York visited exhibits in this museum and tried their hands at building their own.

The metaphor for SciCentr is that of a traditional, hands-on science museum set in the dimension of cyberspace. SciCentr visitors are computer users embodied as avatars, virtual characters that explore and communicate with each other in 3D graphical virtual worlds. SciCentr is experimenting with several design concepts for exhibit worlds. SkyView is a world set under the night sky and contains a virtual observatory that functions in the role of a museum planetarium with changing shows. This project evolved to include a game for teams of players in which users progress through a series of information spaces linked to online information about star formation and then jump quiz hurdles on the way to the observatory. Once in the observatory, users meet the avatar of Marina Romanova, a Cornell astrophysicist, and chat with her to escape to the next level. The spaces in SkyView compile a combination of customized and openly accessible Web content into a structured framework.

SciCentr also includes worlds that present laboratory settings, such as the GeneDome, which feature interactive simulations. In the GeneDome, players each log into their own tomato-breeding station and explore the workings of Mendelian genetics hands-on in accelerated time. The custom, open-ended simulation software, or "bot," underlying the GeneDome is engaging and flexible. CTC works with teachers who develop their own lesson plans for using the simulation. Preliminary results of classroom evaluation suggest that more students show interest in the lab than in more traditional genetics lab activities. Further, students intrigued by the simulation went on to design their own experiment to confirm that it was producing the correct results and ended up deriving their own Punnett square.

visit KQ on the WEB
A full-text version of this column with photos is on the KQWeb at www.ala.org/aasl/kqweb

As a science museum, SciCentr has its own outreach program called SciFair. This program uses a process model (the SciFair Model) to support teams of teens in creating their own knowledge spaces (virtual exhibits with game interactions) with the help of undergraduate mentors from Cornell and trained teachers and coaches at their local schools. SciFair teams work in their own worlds, sometimes creating more than one over the course of a year. While we do not have any school librarians involved, their role in the school makes them ideal candidates for coaching support. Culminating showcase events combine face-to-face and avatar-to-avatar demonstrations of the team projects for families, friends, and peers. In some cases mentors have the opportunity to meet face-to-face with their teams at showcases. However, most participants remain enthusiastic even without face-to-face interaction with their peer mentors, sustained by the social mediation that occurs within the virtual world.

The SciFair Model can be completed in a day or a year. At the core, the training is the same for educators, mentors, and teens. Participants move through stages, first mastering the medium, then taking ownership of their own worlds, and finally working in teams to design, build, and present virtual science communication exhibits. These exhibits represent a new way of organizing, presenting, and sharing knowledge gained through group and individual research, tasks familiar to school librarians. The intent is that the teams create spaces that

are fun and informative, with game interaction that encourages learning on the part of visitors. From CTC's perspective, the value lies in participants creating a personal or group context for a particular area of science and technology that includes references to research at Cornell, as well as personal relationships with the university, thus building a direct link between their interests and our community.

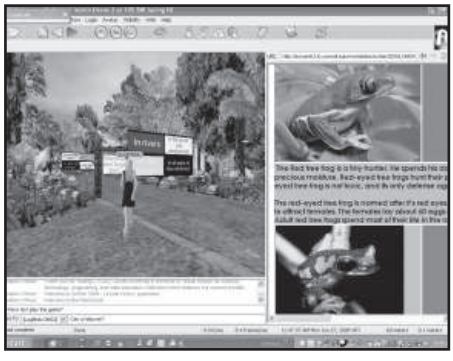
Now in its second year, SciFair is supporting a wide variety of programs across the country. Of seventy-seven teens participating in the programs, sixty-five completed student information forms on which they identified their age, sex, grade, race (optional), and experience in math. Of the sixty-five, thirty-six identified themselves as minority, and an additional nine came from a poverty-level community. There were thirty-six females and twenty-nine males. At the end of the year, sixty-one students rated the program as "good" or better (twenty rated it "excellent"), fifty-two would recommend it to their peers, and forty-three found participation "useful." Anecdotal responses suggest that teen participants found teamwork to be one of the biggest challenges and one of the greatest benefits of the program (Corbit, Kolodziej, and Berstein 2005).

SciFair teens have created alien landscapes, castles, and tropical jungles filled with information presented in interactive formats. In 2003/2004 teens in the SciFair after-school program at Lincoln Orens Middle School (LOMS) in Island Park, Long Island, built a rainforest museum of their own. Filled to the brim with walls of images and animals wandering in the woods, this world is both playful and poignant. The teens were extremely proud of their efforts and presented it to their peers as well as to the superintendent of their district.

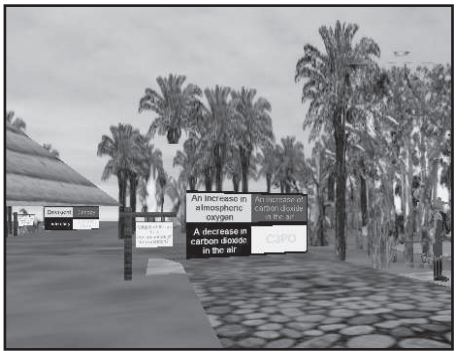
Their LOMS Rainforest Museum is divided into four spaces. These include maze games about the biology of the rainforest accessed through a portal to the "Past" and about issues of rainforest sustainability accessed through a portal to the "Present" as well as a frightening maze filled with animated frogs being destroyed by toxic chemicals in the "Future." The fourth space is a tutorial gallery created during the building process by the team's undergraduate mentor. As the teacher/coach began promoting the project within the school and bringing science classes into this and other SciCentr worlds, she created an online quiz for assessing what students learned from exploring the Rainforest Museum.

Developing Value

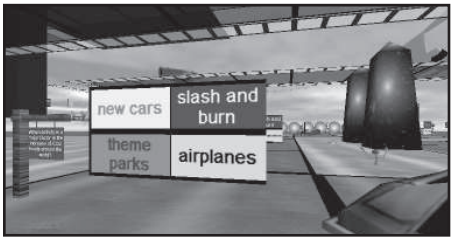
At this early stage in SciCentr exhibit development most exhibits are prototypes and experimental models. However, the content is aligned to national and state learning standards for participating SciFair sites. Teachers trained as coaches are beginning to extend the value of these environments by using them as virtual field trips and supplemental labs. Visitors to SciCentr exhibit worlds are actively engaged in learning within the immersive environment. They are lured by the appeal of the technology and aggressively search for ways to play the game. The challenge is to design worlds that require students to think critically and creatively, to work as teams when called on to do so, and to have opportunities to reflect on what they have seen, done, and accomplished. Design of such interactive content is costly in terms of human resources and will benefit from continued collaborations among the community of educators pioneering this medium.



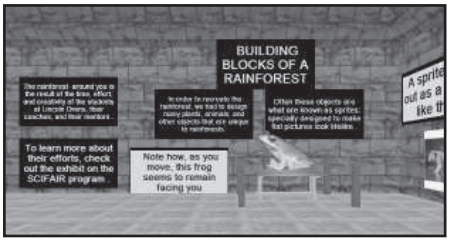
The interface to the LOMS world and their Rainforest Museum (shown above) is standard to the software environment. The avatar (queenbee) explores the rainforest of the Past, while chatting with real and virtual characters through text (boxes below 3D graphical window). At right, Web content (either custom or through external links) is targeted in a built-in browser.



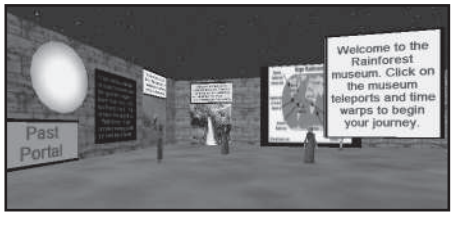
In the Rainforest Museum Present maze, you see reforestation in action on the right and view typical houses lived in by indigenous people. This area includes a wall of contemporary images of rainforest landscapes. The maze stations are linked to Web sites focused on various sustainability issues and you must read and interpret this content to answer the questions and proceed through the maze.



Visitors to the Future maze are greeted with the theme song from The Twilight Zone *on entering. The first station asks them to identify the most important contributor to increasing global levels of CO_2—slash and burn.*



In addition to the student-built spaces, the team's undergraduate mentor created her own gallery featuring a tutorial she developed to teach the teens to master a new technology, creating sprite objects for their world.



The central entry space to the Rainforest Museum provides teleports and time warps to the mazes, orientation information and technical instructions, and access to the mentor's tutorial and history space, as well as a link to the assessment quiz.

There is no doubt that all participants in the SciFair program build fluency in technology, or FITness. Evaluations from teachers, mentors, and students verify that they are learning new skills and exercising ones learned at home or school. For middle school students the benefit can be a straightforward as typing practice, exposure to proper Netiquette, and basic Web research techniques. For teens with more advanced skills, virtual worlds are a medium that allows them to thoughtfully combine digital slide presentations, graphics, and sounds in exciting new ways to represent ideas and information. Some rise to the challenge of modeling their own custom 3D objects and writing plugins (bots) that support custom game features. Undergraduate mentors learn to communicate clearly and coach successfully online using multiple frameworks, from electronic discussion lists to e-mail and instant messaging. They learn to work in a shared file system with Internet servers. Teachers and coaches expand their computing and graphics skills during training and begin to think about ways to apply this new medium to specific content areas. They, too, learn to maintain regular online communication through a variety of modes and get a glimpse of the inner workings of the computing network at their schools.

The experience of building a SciFair world is classically constructivist learning. Teams research, design, build, and present unique projects. They create their own understanding of a topic, which is expressed in many ways. Some are obvious, but difficult to document—in particular, the way students use space in their worlds. For example, one teen designed an animal ecology exhibit that started out in a swamp and ended on a mountain top. Animals featured along the trail are at appropriate elevations. You must explore each space, preferably with its builder, to document such appropriate use of the virtual landscape.

To say that Cornell undergraduates serve as role models for the teens does not suggest the range of those social interactions between mentors and teams. For example, a particularly significant relationship grew between a team at an American Indian reservation school and their mentor, a Native American Cornell student. We know through surveys and interviews that the mentors work hard to get their teams to complete their projects. A large part of that effort is motivational.

Learn More about Computer Games

Aldrich, Charles. 2003. *Simulations and the Future of Learning: An Innovative (and Perhaps Revolutionary) Approach to e-Learning*. San Francisco: Jossey-Bass/Pfeiffer.

Game Studies (journal) <www.gamestudies.org>

Serious Games Initiative <www.seriousgames.org>

Simulation & Gaming (journal) <www.unice.fr/sg>

The Future: Serious Games

In March 2004 the annual Game Developers Conference hosted the first Serious Games Summit and launched the formal activities of the Serious Games Initiative <www.seriousgames.org> supported in large part by the Woodrow Wilson Foundation. The Serious Games movement marks a dramatic convergence for the constructive application of computer game technology. It brings representatives from a community with huge technical and human resources together with educators and trainers struggling not to reinvent the wheel. This effort is supporting cross-fertilization among educational researchers, developers of commercial educational tools based on game technology, military training simulation developers, and commercial game developers looking for new markets and better products. In addition, the community of educational users of virtual worlds is actively sharing their experience with researchers and practitioners at such conferences as the National Educational Computing Conference and Interactive Design for Children. A new book, *Learning by Doing* (Aldrich 2005), characterizes the components of a learning game, outlines the features of digital game technologies, provides a cost/benefit ratio for different applications, and offers clear guidelines for educators wishing to explore developing games for the classroom or for professional training.

School Librarians and Constructivist Gaming

Online and library research are critical to the design in constructivist gaming and are especially important when the games are developed in and for MUVEs. Students investigate geographical features, ecological conditions, biological characteristics, and other researchable content to create authentic simulated worlds. At Chandler Discovery Academy, in Richmond, Virginia, teens used the Cornell Note Taking process to document and prioritize their research for SciFair, reinforcing classroom learning. Students are encouraged to create and scan original or copyright-free artwork for inclusion in their worlds. They are also challenged to find ways to present references for their sources.

As SciFair and SciCentr mature and expand into classrooms, collaborative opportunities for librarians will grow. Learning to coach students in the design, development, presentation, and sharing of digital objects is a critical component of supporting students who create games for others based on knowledge that they have acquired through research.

In addition, there is a more traditional role for librarians in the expanding world of educational games. The Game Design Initiative at Cornell (GDIAC) is a fast-growing program centered in the Faculty of Computer and Information Sciences (CIS). The Cornell Libraries provide multimedia computing resources for students in game design courses and recently have added an up-to-date collection of games as reference resources for the students in this program. As CIS expands its programming in digital media and culture, this collection will become an important resource for scholarly review of the games themselves and their impacts on modern culture. It is now possible to compare the content, objectives, biases, and so on of computer games focused on, for example, human health. We encourage school librarians and university library information science instructors to turn their attention to

gaming as one form of learning experience that will increasingly affect K–12 education. ●

References

Aldrich, Charles. 2005. *Learning by Doing : A Comprehensive Guide to Simulations, Computer Games, and Pedagogy in e-Learning and Other Educational Experiences.* San Francisco: Wiley.

Corbit, Margaret, Suzanne Kolodziej, and Richard Bernstein. 2005. "SciFair: A Multi-User Virtual Environment for Building Science Literacy." Proceedings of the Beijing PCST Working Symposium, June 22, 2005. PCST Network, <www.pcstnetwork.org>.

Dede, Chris. 2005. "Planning for Neomillennial Learning Styles." *EQ* 28, no. 1: 7.

EDUCAUSE. 2005. National Learning Infrastructure Initiative. <www.educause.edu/Games/1008>. Accessed 23 Feb. 2005.

Henry J. Kaiser Family Foundation. 2005. *GenerationM: Media in the Lives of 8–18 Year-Olds.* <www.kff.org/entmedia/entmedia030905pkg.cfm>. Accessed 27 June 2005.

Kerney, Carol. 2005. The Borderlink Project. Imperial County Office of Education. San Diego County Office of Education. <www.borderlink.org>. Accessed 27 June 2005.