NOT POSSIBLE IN REAL LIFE: PRECISION AGRICULTURE'S FUTURE IN 3D VIRTUAL WORLDS

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ABSTRACT

Immersive 3D virtual worlds may be several years away from mainstream adoption, but thousands of scientists, educators, and visionary thinkers are already using these environments to network with colleagues, conduct research, create engaging simulations, and develop instructional models that can reach global audiences. Virtual reality offers the potential to create dynamic content that is either not possible to build in real life, or prohibitively expensive. Travel costs can be reduced by bringing geographically dispersed work groups together to collaborate in real time with a truly immersive feeling of being in the same space.

Cooperative Extension's eXtension Initiative has been exploring the use of immersive 3D for more than two years, within the virtual world Second Life®. Communities of practice are provided with space to construct virtual learning environments, and also technical assistance and training. The newly formed Precision Agriculture community of practice is considering ways to leverage the unique affordances of 3D immersive space for education, collaboration, and outreach.

Keywords: virtual worlds, immersive, 3D, eXtension, Second Life®

WHAT IS A VIRTUAL WORLD?

A virtual world is an online simulated environment accessed by multiple users, simultaneously, through a graphical interface. Users move through the space, which can be either 2D or 3D, with a physical representation of themselves known as an avatar. The world is designed to encourage both interactions with content and with other users. A virtual world is persistent, meaning that it exists

whether or not individual users are logged in. 3D virtual worlds create a sense of co-presence in the same space with other users.

Virtual worlds have been designed for various purposes, with the most common being games. Commercial gaming worlds follow a fictional or historical theme, and users progress through a narrative story that includes tasks, quests, or competitions. Although not explicitly educational, researchers are finding that learning does take place in gaming virtual worlds, especially problem-solving and leadership skills. Surveys conducted by the Pew Internet & American Life Project found that 97% of American teens play video games (Lenhart et al., September, 2008), and more than half of adults do as well. (Lenhart et al., December, 2008).

Researchers are only beginning to understand the implications of the widespread gaming culture. What we might predict is that children growing up playing immersive 3D games will find this to be a very natural, perhaps even expected, way of interacting with educational content.

Social virtual worlds such as Second Life® have many characteristics in common with gaming worlds, but without a narrative story line or explicit goals. At the heart of this type of world is social interaction between avatars, and the ability to create or modify content, manipulate the environment in various ways, and host events. These affordances can also lend themselves to the creation of educational content and experiences, both formal and informal, for school, home, or workplace.

Some virtual worlds are created specifically for educational purposes. Active Worlds, Whyville, and Quest Atlantis are some of the oldest and most widely-used worlds in public school settings, and provide successful frameworks for discovery-based learning. Many other educational "worlds" exist on open source and privately hosted grids such as OSGrid and Reaction Grid. And within Second Life® more than 5000 educators from over 700 colleges and universities are active in research, teaching, collaboration, and professional networking.

WHAT IS SPECIAL ABOUT LEARNING IN VIRTUAL WORLDS?

Immersion and increased engagement with material are key to a virtual learning environment. Tony O´Driscoll, virtual worlds expert and Professor of the Practice at Duke University´s Fuqua School of Business, likes to call this new type of experience the "immernet." O'Driscoll says, "Finally we have a set of technological affordances at our disposal that allow us to create meaningful experiential learning contexts that can significantly accelerate learning." (Eckert, 2009)

These learning experiences range from models not possible in real life, to complex training simulations, and 3D data visualization. Second Life's Education website explains, "There are many distance learning technologies, but we believe that Second Life is the best because it actually feels like you're "there" when you're inworld, and it caters to many kinds of learners — visual, auditory, and experiential." (Linden Lab®, 2010).

Some subjects are a very natural fit with immersive worlds that have a global user base. Language learning, for one, with the ready access to native language speakers is a prime example. Medical technology role play scenario training is

another, and is much more cost-effective to construct than a real-world training simulation.

John Belcher, Faculty, Massachusetts Institute of Technology (MIT), and Fellow, American Physical Society (APS) says "The use of immersive 3D virtual worlds has the potential to transform instruction in many STEM (science, technology, engineering and math) subjects. To effectively capitalize on the potential of virtual worlds in instruction we must first choose subject matter that lends itself to a virtual experience and makes sense in the world created for it." (Belcher, 2010). His work in the virtual world Open Wonderland connects a real-world experiment about electromagnetism with a virtual simulation, creating a new way to address conceptual difficulties of understanding this complex subject matter.

There are many science learning environments in virtual worlds. One of the best ways to understand what might be possible for your own immersive learning design is to visit others and analyze them. Some are closed simulations located behind firewalls, but they may be accessible to colleagues by invitation. An extensive list of publicly accessible science-related places in Second Life® can be found at http://bit.ly/djz6rT .

Other uses: connecting, saving money, working green

Low-cost meetings

A tight economy has brought about a reduction in travel budgets, and significant cost savings are possible for organizations willing to experiment with in-world meetings and mixed reality conferences. In 2008 IBM held their annual meeting totally in Second Life® at one-fifth the normal cost. (Linden Lab®, 2008).

Going green

Reduction of travel miles to real world conferences and meetings, by substituting virtual world venues, has the potential to reduce the carbon footprint of workforce interactions. The US State Department recently held a panel discussion in Second Life® "Virtual Worlds as Green Workplaces?" to explore this topic. Current virtual worlds architecture requires significant energy to power servers that are always on, but as these systems become more efficient, or even "cloud-based," the savings will become compelling.

Professional networking

Of his Second Life® experience, Bill Freese, Director of Media Services at Montana State University says, "I've become involved with my national professional organizations in a way that I never was before. What used to be a journal I skimmed, or a conference I could not attend, was suddenly a collection of people I could interact with every day in a virtual face-to-face way...I've been involved in more professional development in the past year than in the previous twenty." (Ragan-Fore, 2009)

eXtension IN SECOND LIFE®

In 2007 eXtension began to explore virtual worlds with the purchase of Morrill Island in Second Life®. Bimonthly "meetups" were held to familiarize eXtension associates with the technology, to learn more about the functionality of Second Life, and to share ideas about how it might be used productively.

In 2008, the formal launch of the eXtension Initiative in Washington, D.C. included a parallel celebration in Second Life®. The Virtual State Fair was constructed as a place for the virtual launch event and also to become the anchor for further projects within Second Life®. A weekend of fair activities brought over 1000 avatars to visit the venue.

From 2008 forward, eXtension's land size has increased from one "island" to four. Weekly activities include orientation for our internal audience, and tours for a variety of groups. The residents of Second Life® continue to visit both to enjoy the fair and to experience the educational content. The Morrill Islands are full of dynamic content, carefully managed by our sim administrators, ensuring a quality experience for every visitor.

Current Learning Environments

The LiveAbility House is a project of the eXtension Family Caregiving Community of Practice, led by Dr. Debra Sellers of Kansas State University and Dr. Sarah Kirby of North Carolina State University. The goal of this initial project is to raise public awareness about universal design (UD) and assistive technology (AT) that enable a person to live at home despite physical or mental challenges caused by aging, illness, or disability. The project consists of a one story house with over fifty features numbered and color coded with orange dots for UD or purple dots for AT. Each dot can be clicked to hear and see descriptive information and a photo of the item in use. A page has been created in the eXtension website describing the project.

The Life Cycle of the Japanese Beetle (Fig. 1), conceived by Jeff Fowler, Regional Turfgrass Educator from Penn State Extension, takes visitors underground for a close-up view of how the beetles lay eggs which develop into white grubs that feed on the roots of the grass. The immersive tour is narrated as the learner goes through the experience. The content is offered as an in-world lesson, or as part of an online course using videos of the content recorded with screen capture. Additional instructional materials are presented about methods of control, both effective and not. Fowler observes, "For as many years as we have been teaching about grub life cycle and development of new control methods, we have never before given the learner the opportunity to see the development of egg to adult."

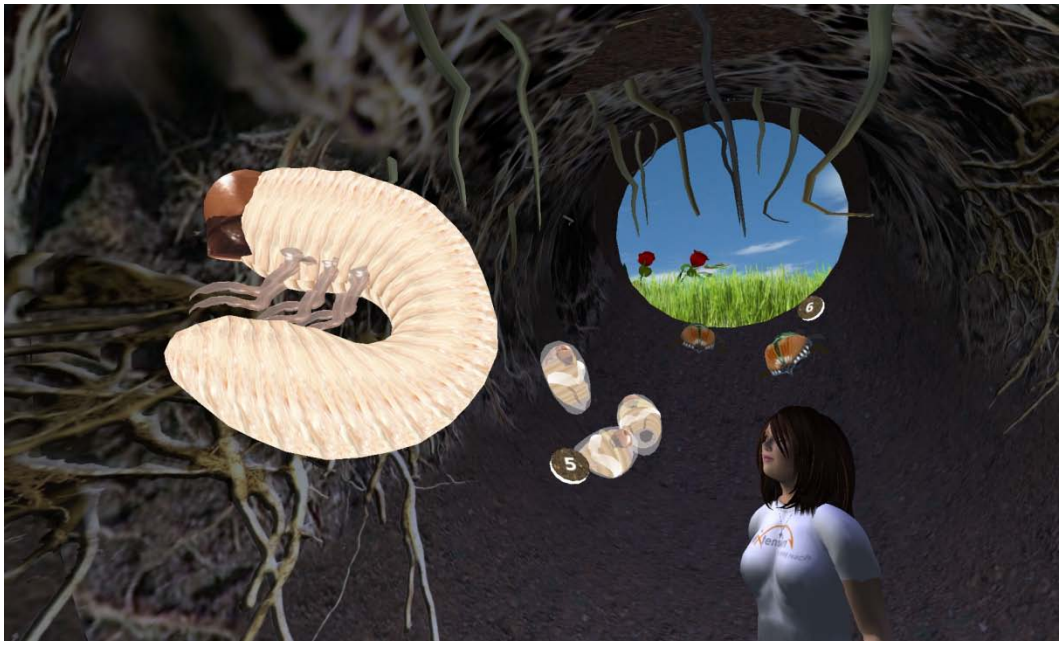

Fig. 1. Life Cycle of the Japanese Beetle exhibit in Second Life®

The Virtual Health Inspector Game was developed by Kristin Woods, Regional Food Safety Educator with Alabama Cooperative Extension, and it is now a project of the eXtension Food Safety Community of Practice. Students play the role of food safety inspectors from the local health department, seeking sixteen sources of food borne pathogens in the local diner. Each food safety hazard is tagged with educational content. A report filed by each inspector serves as an evaluation tool. When pre-arranged, the diner can be staffed with live characters such as a waitress and cook, to enhance the learning experience.

The Integrated Pest Management Warehouse and Spray Drift Simulation comprise an area developed jointly by Betsy Buffington of Iowa State University Extension, and Erin Bauer of University of Nebraska Lincoln. The pest warehouse contains a full set of pest applicator protective gear, along with lessons in proper handling of chemical pesticides and contaminated clothing. There is also a lesson on dealing with a mouse infestation, and a slide presentation about Integrated Pest Management. Outside the warehouse is the starting point for Buffington's drift simulation, in which a student can ride upon a drifting spray droplet to its eventual destination in a pond, a bee hive, on a clothesline, and a backyard vegetable garden.

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The Smith-Lever Farm Case Study, by Dr. Martha Mamo and Dr. Deana Namuth-Covert of Nebraska-Lincoln, created an immersive learning environment focused on groundwater contamination from application of herbicide on a cornfield. Students in a freshman level Soil Resources course participated in a simulation problem for the purpose of obtaining some preliminary data about the usefulness of Second Life® as an instructional environment. The students in-world collected data in various locations throughout the sim, while another group of students did the exercise with paper and pencil. Feedback from the initial trial provided useful insights for further design iterations that will better leverage the unique properties of the immersive 3d space.

What is the strategy for eXtension Virtual 3D?

eXtension currently supports four sims in Second Life®, one in Teen Second Life® (for ages 13-17) that can be used by anyone in the Cooperative Extension system for orientation, meetings, events, and teaching. Facilities include the Virtual County Extension Building with classroom space, the Virtual State Fair, a conference center with flexible meeting spaces and multimedia capability, and orientation area and sandbox for learning to build, and the learning spaces described above. Staff time is dedicated to support these activities.

Larger projects are considered on a case-by-case basis, based on staff availability and sim resources. The rationale for the project must take into account sound pedagogy, with clear instructional goals. The design team must reflect a collaborative effort involving members of an eXtension Community of Practice, eXtension staff, and possibly outside contractors. A project involves many skills: subject matter expertise, instructional design, graphic arts, scripting, programming, building, animation, project management, and evaluation. Larger projects are encouraged and can be supported with additional funding from university resources, grants, or sponsors. Over time, eXtension hopes to create a contiguous "learningscape" involving all of the Communities of Practice.

A learning environment on the Morrill sims can be used in many ways. The in-world content first becomes a peer-reviewed learning lesson in the Community of Practice content area of www.extension.org. A video lesson (known as "machinima") can be created, and posted in web pages, blogs, or used as part of presentations. Classes can be held live in the virtual space, either by bringing a class in-world with their avatars, or by using the instructor as a guide with the content projected on a screen. A hybrid lesson can be created using a content management system such as Moodle. Audiences can include formal classrooms, community-based programs, conference sessions, or informal self-directed learners. Participants can be from your local community, or anywhere across the globe. This is a very flexible, multi-purpose type of learning experience.

Some Challenges

While virtual worlds present many unique and special opportunities for the future of education, there are a few stumbling blocks to be considered along the way.

- Technical issues: sufficient bandwidth, hardware requirements, firewalls
- New user orientation: steep learning curve, complex user interface
- Pedagogical goals: not just the "wow" factor, using the immersion and 3D creatively
- "Play" stigma: Virtual worlds viewed as a place for recreation, not education
- Rise of mobile devices: How well can immersive 3D adapt to smaller screens?

Potential uses of virtual worlds for Precision Agriculture

There are many possible uses of immersive virtual worlds for the Precision Agriculture community.

- Meeting and collaboration with global colleagues and partners
- Educating the public about Precision Agriculture
- College classes held in virtual space, especially for distance learners
- Prototyping of complex projects
- 3D data visualization
- Feeding data from remote sensors to virtual worlds, to "grow" virtual crops that mirror real
- Mapping of GIS data onto Google maps for shared viewing and analysis

CONCLUSION

Virtual worlds used for 3D immersive education is quietly approaching wide-scale adoption as a way to engage a new generation of learners in a new kind of experiential learning. The eXtension Initiative is committed to exploring the use of virtual worlds for formal and informal education, research, and global outreach. An active community of extension educators is involved in ongoing projects in the Second Life® virtual world.

This technology has many special affordances: providing a way to see things not possible in real life, bringing a global audience together with a sense of presence in place, creating interactive "learningscapes" that can be used over and over in a variety of ways. Precision Agriculture is a discipline that could use virtual worlds in various productive ways, and eXtension encourages this community to explore the possibilities.

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