Changing Logo from a Single Student System to a 3D On-line Student Collaboratory/Participatory Shared Learning Experience

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The concept of Logo to support constructive learning has been in existence since the 1960's. Logo as implemented in computer software in the 1970's has focused on either single student to single computer or a group of students sharing a single computer. Later versions of Logo have supported multi-user networking, but have not truly provided a shared learning environment where students using single systems at distant locations can work together and view each other's work. This paper will discuss the potential of combining Logo concepts with on-line 3D environments to create engaged participatory learning environments/experiences for students. This approach could expand Logo so that it can allow classrooms connected by the Internet to simultaneously engage in K-12 projects about mathematics, language, music, robotics, telecommunications, and/or science. This paper and the presentation at the TCEA conference will demonstrate what an on-line 3D participatory system looks like and show the initial software modules developed for classroom use.

Logo

One of the primary purposes of the Logo programming environment is to support constructivist learning, such that students create knowledge through interaction with other people and the world around them. The Logo Programming Language, a dialect of Lisp, was created in the 1970's to promote the concept of Logo as a learning tool (What is Logo, 2003). The turtle comes from the original robotic creature (figure 1), created by Marvin Minsky with Seymour Papert, that sat on the floor and could be directed to move around by typing commands into the computer (Minsky, 2003). With the advent of the personal computer, the mechanical turtle migrated to a graphical one displayed on a computer display. In 1980, two pilot projects sponsored by MIT and Texas Instruments were begun at the Lamplighter School in Dallas, Texas and at the Community School Districts 2, 3, and 9 in New York City. Theresa Overall, one of the authors of this paper, was a leader in both the Dallas and New York projects. The results from these pilot projects and the continued use of Logo in the classroom over the past twenty years have resulted in a vast collection of curriculum materials that utilize Logo.

Figure 1 – "turtle" (A Logo Primer, 2003)

Logo is not a programming language that once learned is used exclusively to create other software applications. Seymour Papert believes that students creating their own software is one of the powerful ideas of Logo (Page, 1999). The Logo language promotes modularity, interactivity, and flexibility, and this richness of the language acts as a vehicle for the exploration of other knowledge areas such as math and science. Young children using Logo are able to explore the world of geometry in a concrete, rather than abstract, way. By moving the turtle around the screen using the commands forward, back, right, and left, they investigate angles, lengths, and the construction of geometric shapes. A student trying to draw a picture of a birthday present may get to the right angle corner of their gift and try using the command "Left 100". As they move the turtle forward to draw the next side of the package, they see that the new line is not exactly what they had in mind. Whether they choose to go back and modify that turn, or decide to accept having a package with a crooked side, the learner begins to have a concept of exactly how big 100 turtle turns really is (the abstract term "degrees" can be applied to this concept later). As students become more proficient in their programming with Logo, they look for more efficient ways to accomplish their designs. A fourth grader wanting to be able to draw a castle turret in various sizes can use variables in her program so that one self-created procedure (perhaps she calls it "turret") can be re-used. For example, the command "turret 100 50" might draw a castle turret with height 100 and width 50, while "turret 100 20" would draw a turret of the same height but smaller width.

Today, several companies support Logo-based applications that are used in the classroom. One popular application used is Microworlds developed by Logo Computer Systems, Inc. (LCSI Microworlds, 2003). Figure 2 shows a screenshot of Microworlds. These new applications have moved beyond a single turtle moving around on the screen into the realm of authoring tool.

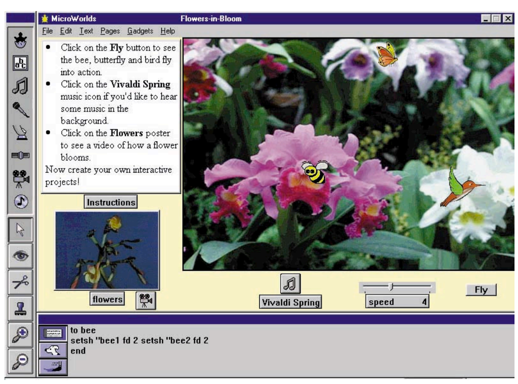

Figure 2 – Microworlds (LCSI Microworlds, 2003)

Moving Logo towards a Collaboratory/Participatory Shared Learning Experience

On-line collaboration systems are not new. MOOs (Multi-User Object-Oriented) have been used for learning, training, and collaboration since the early 1990's. The MIT Media Lab demonstrated that virtual meeting spaces have significant potential for training and collaboration (Bruckman, 1992). Only recently have immersive graphical environments been created for on-line interaction. The first wave of 3D graphical MUDs

(Multi-User Domains) began in 1999 with the release of Everquest developed by Verant (Sony, 2002).

There have been attempts to provide on-line 3D environments over the past ten years, but the primary barrier to success has been the cost and availability of personal computers equipped with 3D graphics adapters. Since then, more entertainment titles have been developed. These software titles reflect the number of personal computers capable of supporting or being upgraded to support these advanced 3D graphic interfaces. In 2001, over 70% of PCs with Windows OS shipped supported a 3D video graphics adapter (Jon Peddie Associates, 2001). Internet connectivity and computers equipped with 3D graphics are no longer a barrier to access.

Created Realities Group (CRG) has created an educational distributed learning system for delivering interactive course materials. The created realities concept is to take current off-the-shelf commercial approaches that provide contextually accurate software-derived 3D environments and then overlay collaborative groupware, unified communications, and other instructional tools to create a single distance/distributed educational delivery interface. The use of state-of-the-art real-time rendering on consumer PC platforms allows students and instructors to have a 'lean-forward' (engaged) seamless peer-to-peer educational experience. (CRG, 2002) Figure 3 shows a screen shot of the college/university environment being used by the Department of Technology and Cognition at the University of North Texas.

Figure 3 – Example of a University/College 3D environment setting.

The potential now exists to combine on-line immersive interactive systems with collaboratory/participatory shared learning models that can be used in most schools in the United States. These types of systems would allow students in the same classroom or in different classrooms to work together to construct knowledge through participatory environments. Logo is one such approach that could be placed into this type of system to allow students to views each other’s work at the same time and to develop in groups. We are now working with CRG to develop the initial participatory simulations to demonstrate the concepts being discussed in this paper.

In the traditional Logo realm, the background was a blank slate. The drawings that students made using the turtle were the focus. When multimedia capabilities became available, wallpaper patterns, colorful graphics, and even text made backgrounds more interesting. But they were still backgrounds and the learning focus is on the programming and turtle geometry. In 3D online systems, the background has an opportunity to be its own learning environment. Students can still use geometric and algebraic skills to program their avatars to move around the environment, but there are more choices for background environments. Because of the ability to create the environment the avatar interacts with, a student can be virtually exploring the surface of Mars or the details of the Earth's ocean floor under the polar ice cap. Figure 4 shows a screen shot of the summit of Olympus Mons displayed by the CRG system.

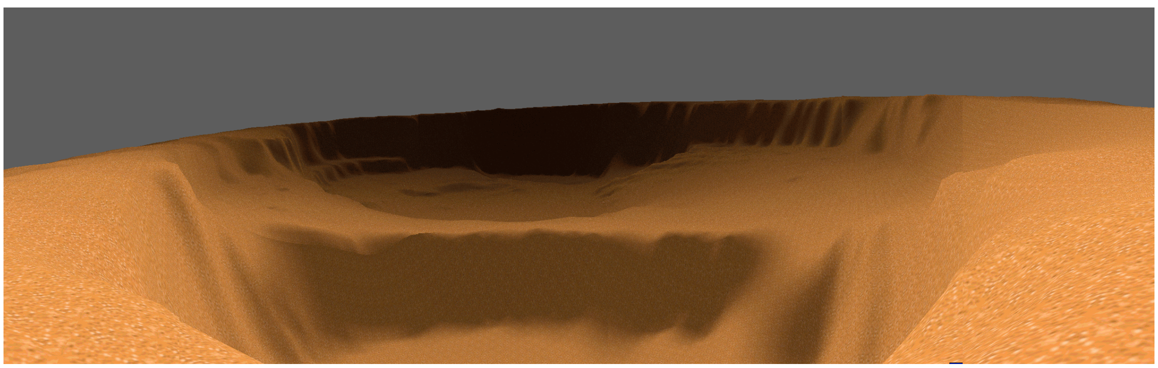

Figure 4 – Example of the Mars 3D environment generated in real-time based on NASA MOLA data. Panorama Shot of Olympus Mons, Top Cone (MARS_19.0_227.0).

Seymour Papert described Logo as a "Mathland" (1980). Just as it is easy to learn French if you live in France, if there was a Mathland where Math was the native language, you would easily learn the language Math. Part of the way we learn a language is by using it to communicate ideas of our choosing. It should be possible in the 3D online environment for a student to just as easily and naturally learn about Mars or the ocean floor through exploration, feedback, and personal motivation. Another aspect of language acquisition is that we receive feedback from those with whom we are communicating. Parents and teachers correct our grammar, friends ask questions when what we say doesn't make sense. The interaction among multiple users in the online learning environment has the potential to provide that type of feedback as well.

In some versions of traditional Logo, there was a capacity to set the velocity of a turtle. Using commands such as setXvelocity or setYvelocity, users explored vectors and many powerful physics ideas. Often, in traditional physics classes, students have to read about physics concepts and use their imagination to figure out what is being described or they have labs where they can experiment with physics notions, but have to always take into account friction and gravity. Vectors can be complex enough without adding additional forces of friction and gravity. To be able to explore velocity visually and through experimentation with individual vectors (for example, set the velocity in an X direction and then add a vector of velocity in the Y direction) is an exciting way to understand the world of physics. In a 3D environment, the potential is added to set the velocity in a Z direction. Another feature of Logo3D is the ability to change the location of the observer. Are you standing on the Z plane looking at X-Y in front of you? Or would you rather be “above” the action and see the X-Z plane while “standing” on the Y plane? This has great potential to impact the learning of physics as well as perspective geometry and other fields in math and science that have traditionally been considered “too abstract” for younger learners or novice scientists and mathematicians.

Figure 5 shows a screen capture of the initial prototype Logo3D development. What was the most intriguing outcome of this prototype was the feedback we got from people interacting with the presentation of the information. The balls and lines represent solar systems connected by different types of faster than light travel (sci-fi gaming concept). We had people, who were interested in the mock game concept, log into the 3D environment and then were asked questions about distribution of lines (jump gate technology) to balls (solar systems) through the audio and text chat features. As we asked questions and the participants gave feedback, we would change variables in the script and then redisplay the model. People were very engaged with the model, because they could interact with it by moving around and through the model while it was being generated and at the same time discuss the topic with audio or text with other participants. It would have been that much more powerful is the participants could have been able to share control of the script as a group. The prototype has given us good feedback and is driving aspects of the current design.

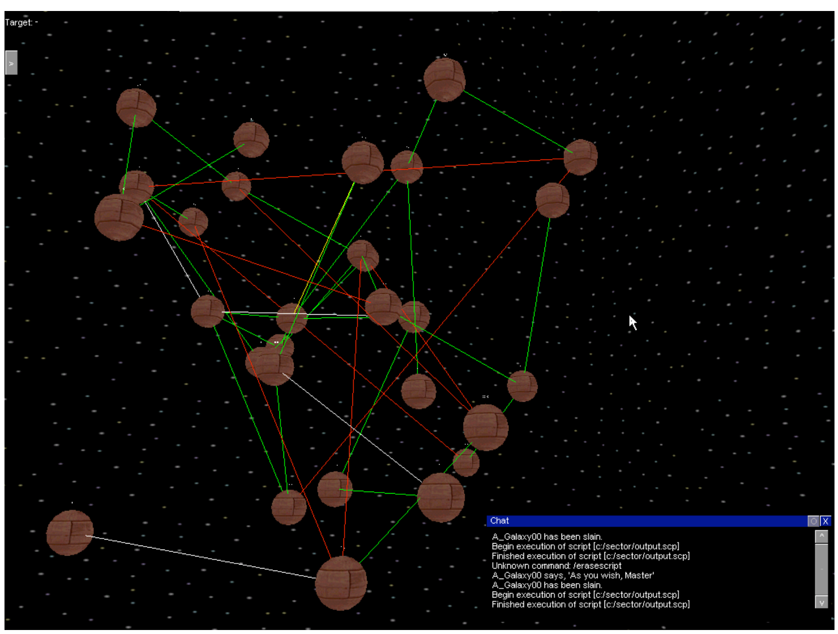

Figure 5 – Screen Capture from the Logo3D prototype.

Conclusion

We are looking forward to moving ahead with this development. Before we can complete the first version of the Logo3D project, several enhancements to the CRG core system are required. We are in the midst of those changes now and hope to complete them in the coming months. Once these new elements are in place within the CRG core system, it is our goal to have the first version of Logo3D expansion module development completed. Educators and Logo enthusiasts interested in this project should contact the authors for more information.

References:

A Logo Primer. (n.d.) Retrieved May 10, 2003, from http://el.media.mit.edu/logo-foundation/logo/turtle.html.

Created Realities Group (2002). Overview of the Created Realities Group VXInteractive Distributed Learning System. Retrieved September 14, 2002, from http://www.created-realities.com.

Jon Peddie Associates. (2001). Software tools and applications series: 3D visualization and simulation market study. Retrieved August 15, 2001, from http://www.jpa.com/studies/vizsim/index.html.

LCSI Microworlds. (n.d.). MicroWorlds 2.0 for Macintosh and Windows 95/98/NT/Me/2000/XP Users. Retrieved May 10, 2003, from http://www.microworlds.com/solutions/mw.html.

Minsky, M. (2003). MIT Bio. Retrieved May 10, 2003, from http://web.media.mit.edu/~minsky/minskybiog.html.

Page, D. (1999, February). Seymour Papert: Computers, Kids & Powerful Ideas. Converge Magazine. Retrieved February 2, 2004 from http://www.convergemag.com/Publications/CNVGFeb99/inclose/inclose.shtm.

Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas. New York: Basic Books.

Sony Online Entrainment: About Everquest. (n.d.) Retrieved September 9, 2002, from http://everquest.station.sony.com/about.jsp

What is Logo. (n.d.) Retrieved May 10, 2003, from http://el.media.mit.edu/logo-foundation/index.html.