Building A Virtual World For Learning

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Abstract

This paper will discuss the prototyping process used to develop a Second Life environment designed to teach graphic principles of unity, contrast, and emphasis for instructional message design. It describes the process and results, and suggests a framework for the design and development of virtual learning environments (VLE's).

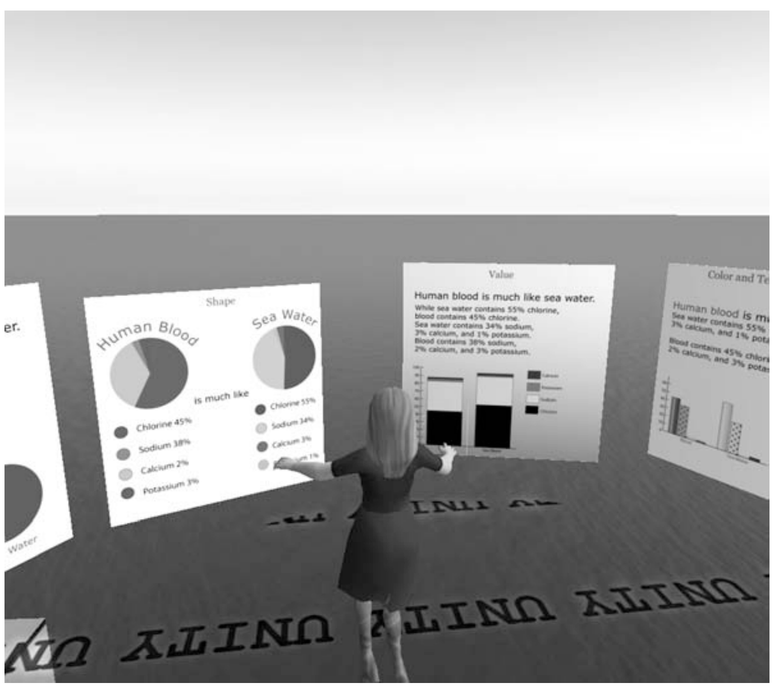
Introduction And Problem

Use of media in instruction has increased dramatically in the last two decades. Teachers and instructional designers are often asked to create visual designs for websites, power point presentations, or even to illustrate concepts. Without an understanding of visual design principles, these presentations can fail to communicate the desired message.

Graphic unity within an image can simplify a complex message making the message more accessible to the consumer. Absence of unity can make even a simple message inaccessible. Educators and instructional designers are well advised to learn the design principles of unity which can be achieved through visual contrast and hierarchical emphasis, as part of their visual literacy training.

In response to the need for visually literate instructional designers and educators, the authors are designing and developing a tutorial for teaching graphic principles of unity, contrast, and emphasis for instructional message design. The lesson module is named "Unity, Contrast, and Emphasis", and will be delivered through the web based virtual world Second Life (SL). It includes graphic illustrations of visual design concepts that students can examine at their own pace. Figure 1 shows an *avatar*, an interactive graphic representation of a student, standing on the Unity floor of the tutorial.

Figure 1
Avatar On The Unity Floor



Why Second Life?

Virtual reality was originally used to create highly immersive simulations for training in situations where placing the student in a real setting was impossible, dangerous, or too costly. Immersive virtual reality systems were expensive to develop and maintain. Recently, web based 3D virtual worlds have been developed that can be accessed and edited using ordinary desktop computers. Of the available public 3D virtual worlds, Second Life is the most widely known. Dozens of educational institutions have established presences there.

With the introduction of new technologies, comes the need for research into their effectiveness. Virtual learning environments have unique affordances not found in other multimedia learning programs. Learners can immerse themselves, interact and move in a three dimensional virtual space, and experience a sense of spatial presence there.

The design goal for this project is to create a learning environment that combines synchronous and asynchronous activity and utilizes the affordances of Second Life for the events of instruction: presentation, guided practice, practice, evaluation and reflection. Analysis of the design process and results will expand knowledge on the use of virtual learning environments and obtain some answers to the question: "What effects do the unique affordances of VLE's have on learning outcomes?" This will include recommendations for designing environments that are intuitive to navigate and do not add unnecessary cognitive load.

Presence In Virtual Worlds

Like multimedia, virtual worlds can include interactivity, images, sounds and text, as well as hyperlinks to other websites or media. But virtual worlds have an additional affordance that the literature calls presence. Presence is the users' feeling of *being there*, in the virtual world. Presence is important in virtual worlds to help users accomplish learning goals (Jacobson, 2001) and is reported to have positive effects on students' perceptions of course communications and relevance (Nishide, Shima, Araie and Ueshima, 2007; Reznick and MacRae, 2006; Takatalo, Nyman and Laaksonen, 2008).

Spatial presence is achieved through the vividness of imagery, and the user's ability to interact in the virtual world. The immersive quality of spatial presence affects how learners interact with and react to the space.

Theoretical Foundations

Currently, most educational programs in virtual worlds are designed around constructivist learning theories. Those theories suggest that deep learning is achieved through active student involvement in the learning process. This includes paying attention to relevant information, organizing it into cohesive structures, and connecting it to existing knowledge. Two constructivist learning theories, Spiro, Feltovich, Jacobson, and Coulson's 1995 cognitive flexibility theory (CFT), and Mayer's multimedia learning theories (MLT: 2001), frame our development process.

Cognitive flexibility theory presents a set of principal recommendations for the development of instructional hypertext programs to promote successful learning of difficult subject matter. Virtual reality offers an unlimited opportunity for non-linear, complex, intertwined media and content. Designers can build a virtual landscape, full of rich representations of concepts in many forms. While linear environments have what CFT calls a "reductive bias," virtual reality promotes cognitive flexibility because of its flexible, simultaneous affordances for multiple representations of knowledge, social interactivity, and collaborative construction of objects.

Virtual worlds are rich multimedia environments. Mayer's 2001 theories are based upon dozens of empirical studies that measured the effectiveness of multimedia affordances on retention and transfer of learning. The theories establish principles for using multimedia to obtain effective learning outcomes in retention and transfer of knowledge.

Design Goals

Design and development goals for the Second Life virtual learning environment include the following:

- Design and construct a VLE that can be used to teach concepts by presenting illustrations of examples and non-examples.
- Develop strategies for including the events of instruction: presentation, practice, synthesis, and reflection in the VLE.
- Design navigation that enhances the sense of spatial presence, but is also transparent and intuitive. Interactivity is an important parts of spatial presence, so user control should be primary method of navigation. Program controls can be built into the underlying structure.
- Integrate explanations, and instructions into the VLE.
- Convert visual design recommendations for static or interactive 2D learning environments to the additional spatial dimensions of the VLE, taking into consideration its unique affordance of spatial presence. Optimize clarity, legibility and organization of content for users.
- Adhere to MLT in construction of elements and organization of learning objects; incorporate CFT in presentation, navigation and communication options.

Process

Because there are few precedents or models for this type of VLE tutorial, the design process follows Richey and Klein's 2007 recommendations for product and tool research, with emphasis on comprehensive design and development. Prototyping procedures followed processes described by Smith and Ragan (2005), coupled with principles of rapid prototyping (Jones and

Richey, 2000), and thoroughly documented design and development methods to report design issues.

The Tutorial Content

In "Unity, Contrast, and Emphasis" learners can view examples of visual design principles at their own pace. The tutorial is divided into seven learning modules. Each module includes assessments of learners' understanding of the concepts presented in that module, and their ability to apply the concepts to an instructional message design. Students write image analyses of examples that illustrate each module's topic, and then create their own learning objects using the principles that were presented in the module. Completed assignments will be submitted to the real life teacher.

Design Issues

The Second Life interface has unique affordances for navigation, interactivity, and communication. CFT and MLT will be the theoretical foundations for making design decisions to integrate the affordances into the events of learning.

Space

Laws of physics are flexible in virtual reality. Users can fly and walk through walls, contingent on the designers' plan. The available virtual space where the tutorial could be constructed was a relatively small area. But the vertical dimension was almost unlimited. So a vertical interface was designed, seen in Figure 2.

Figure 2
The Vertical Design
Makes Use Of The Available Space

Communication

A major consideration in the tutorial's design will be the delivery of instructions for its use. Figure 3 shows the tutorial start menu. Each block can deliver to the student a note card with instructions on how to proceed. A text *whisper* appears when an avatar passes close by the menu. It announces the presence of instructional aides and instructs the user to access them by having the avatar touch the blocks.

Figure 3
Avatar At The Tutorial Start Menu

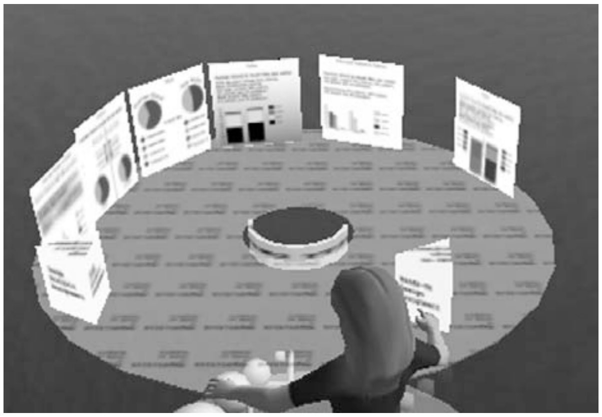
Visual Design

The tutorial includes illustrations of visual design concepts used in instructional messages. It demonstrates how to create unity in an instructional message by repeating forms (line, point, plane) and elements (size, shape, color, texture, direction, opacity, volume, line, placement), and how to achieve emphasis by using contrasting forms and elements.

Interactive virtual worlds allow the user to choose and to some extent control their point of view of the virtual space and the objects in the space. This places the burden of finding the correct viewpoint on the user. The graphics and architecture found in many SL environments are designed for avatars, not for the user at the computer workstation.

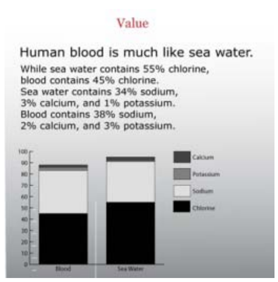
Maneuvering the avatar to a position where it can see the graphic clearly can require awkward manipulations of keyboard and mouse by the user. To minimize keyboard manipulations that might add cognitive load, the presentation graphics are arranged in a circular design on each floor, as seen in Figure 4.

Figure 4
The Presentation Graphics Are Arranged In A Circular Design

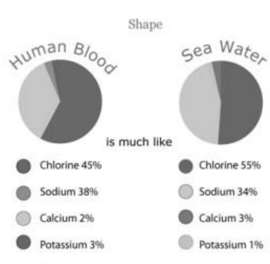


The avatars enter through the center of the floor, and then use the arrow keys to rotate around to view the different pieces. This is easier and requires fewer keystroke manipulations than moving the avatar in a rectangular environment. Figures 5A and 5B show the presentation graphics displayed on the Unity floor.

Figure 5
Graphics Showing Use Of Value And Shape In Instructional Messages



5A



5B

The graphics are *phantoms*, meaning that the learner can fly through them at will. This also helps eliminate awkward keyboard manipulations that can result from maneuvering in a closed virtual space.

The circular arrangement was the current best solution for this design, but in future iterations other possibilities will be considered. For tutorials that rely heavily on graphics to illustrate a concept, in-world slide presentations or photo albums that learners can save to their inventory are two possible solutions. Flash animations that point out specific features of graphics could be added to presentation boards in place of static graphics. Another approach might be program controlled graphics that self adjust to the user's viewpoint.

The presentation graphics contain supplemental information in the form of note cards that are activated when the learner's avatar touches the graphic. The note cards can contain text, graphics, and animations, even links to other websites or documents.

Program controlled whispers are activated when an avatar passes within a certain range. Whispers and note cards are also embedded in the assignment drop box shown in Figure 6.

Figure 6
The Whispering Assignment Drop Box

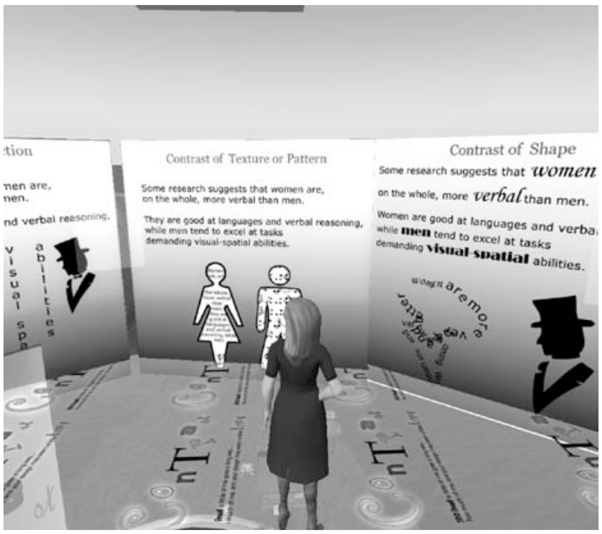
Interactivity

The guided practice assignments include examples of graphic messages with varying degrees of unity, contrast and emphasis. Students download the examples onto their computers and use professional image editing software to revise and improve the images, then apply strategies learned during their interaction with the tutorial to create appropriate hierarchical emphasis in the instructional messages.

Students participate in a class critique after completing each topic assignment. However, they are free to explore the tutorial and all topics at any time. Because the visual design principles are interrelated, this flexible (rather than linear) presentation of content fits cognitive flexibility theory recommendations.

Each part of the tutorial provides links to additional resources. Scaffolds in the form of worked examples and automated guidance to help students assess their designs-in-progress are also built into each module. The Contrast floor is shown in Figure 7.

Figure 7
The Contrast Floor



Students work individually on the preliminary modules, and collectively within a peer group of students with similar interests on the final project. Students receive feedback from the group on one another's designs as well as formative feedback from the instructor as they develop each design. A final class critique with the instructor on the completed designs provides summative feedback. Because the process is visible to all, design decisions made by peers and feedback from the instructor are transparent.

The Virtual World

Formative evaluation of this first iteration of the tutorial confirmed our goals and drew attention to specific areas of concern. The most significant issues involved participant navigation in the virtual world and design of the virtual landscape and objects to optimize the individual learner's point of view.

To incorporate Spiro's 1995 cognitive flexibility theory, navigation has to be flexible and allow different methods of exploring the space, subject matter, and resources. Second Life's basic affordances for navigation include avatar controls for walking, running and flying, and world view controls for zooming and panning. Other scripted methods of movement within the virtual space can be added. These include virtual transporters, elevators, helicopters, and hot air balloons. Each of these metaphorical navigation devices provides different amounts of user and program control.

The potential for differences in the amount of user control for navigation lead us to ask, "How will the amount of program controlled movement vs. user controlled movement affect the user's sense of spatial presence?"

We allowed students to fly through a marked pathway to move from floor to floor. This highly interactive method increased the users' sense of presence, but took several seconds or longer. An instantaneous transportation device could have been used instead. Other navigation options might include a meandering hot air balloon that would follow a prescribed path, or a helicopter with user controls for speed and type of movement.

In future iterations several transportation devices will be available to learners to accommodate their learning needs. Program controlled slow devices might include stops for enrichment material or scaffolds. Instant devices would allow learners to go directly to the desired area of the tutorial.

Eventually some of the navigation issues may be resolved by new technology. Interactive holographic displays and motion and bio-feedback pointing devices are already available in high end applications.

Conclusion

Our virtual learning environment in Second Life, "Unity, Contrast, and Emphasis," demonstrates the power of virtual worlds for affording collaborative, constructivist learning. Drawing upon cognitive flexibility theory and multimedia learning theory, and our design and implementation experiences, we identified the following key design considerations for creating virtual learning environments.

Space

> How much virtual space is needed and how will the user experience this space? How will the user's avatar move around the space?

Communication

> How will instructions be delivered? How will presentations (lectures) be delivered? How will the instructor communicate with the students and how will the students communicate with one another?

Visual Design

> How can the visual arrangement of the virtual content be optimized to reduce cognitive load, increase spatial presence, and enhance learning? What visual metaphors or forms will be used to organize the space?

Interactivity

Which activities will be program controlled? Which activities will be user controlled? Should the users select the order in which they view content and their methods of navigation? Or should the program dictate these in controlled steps? How will these decisions affect the users' sense of spatial presence?

The Virtual World

How will learners learn to use the virtual world tools? How much knowledge of the virtual world is necessary for learners to successfully complete the tutorial?

These issues will be studied as the design and development of this tutorial progress. Future evaluations of the tutorial will add to the body of knowledge on effective methods of creating instructional designs in virtual learning environments.

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