Bespace: A Multi-user Web3D Lecture Hall

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ABSTRACT

Bespace is a web3D lecture hall. It is a synchronous online environment capable of presenting diverse forms of educational content. Bespace's methodology positions presence, realism, and immersion as tools for moderating student behavior and achieving educational outcomes. Secondly, Bespace explores the strengths and limitations of digital worlds — the impact of mouse, keyboard, and computer screen on the design of virtual space. The key to Bespace is deceptively simple; the teacher's avatar is empowered like a videogame character. The teacher's avatar shape-shifts into 2D slides, 3D models, and 3D worlds. The result is a native space blending interface and environment design.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General terms: Design, Human Factors, Performance, Design, Experimentation, Theory

Keywords: Web3d, synchronous learning, avatar

INTRODUCTION

The rise of technologies like Second Life highlight the value of synchronous web3D as tool for online learning. Problems with asynchronous systems such as the lack of presence (*teacher, social, student*) and providing student motivation to complete assignments are, in part, addressed by synchronous web3D [1][2]. While approaches and levels of success vary, countless books and papers offer praise for the application of immersion, presence, simulation and synchronicity in regards to learning [1][2].

To move forward is not to restate the potential educational value of web3D, but to consider the design of a web3d space that delivers that value. A space that exploits the HCI principles of structuring data, managing cognitive load, and the removal of unneeded steps in interactions [3]. With this focus on design, Bespace is software agonistic. The shape-shifting of the teacher's avatar is a simple reprogramming of gestural code and can be done within Virtools, Second Life, Shockwave 3D, or Active Worlds. Bespace uses ABNet, an X3D platform.

The best way to engage Bespace is to simply walkthrough the prototype's initial lecture: *Darwin a Man and His Times*. Questions of HCI and design choices are addressed in the section that follows the walkthrough. A preliminary usability study has been completed and it addresses the HCI claims of Bespace. This paper then concludes with a brief look at the implications of Bespace and the impact freeing web3D avatars from faux humanoid form. This paper is laid out as follows:

- Visual Walkthrough: *Darwin a Man and His Times*
- Theory: *Design Choices and HCI Considerations*
- A Preliminary Usability Study
- Conclusions

WALKTHROUGH

The Bespace *Darwin a Man and His Times* lecture is a culture of science presentation geared to college level students and a class size of 10-15. The lecture itself is introductory in terms of interactivity. Not shown in the images is the use of VoIP (Ventrilo) and to save space, the text chat window is removed from images. It also is important to note that Bespace does not dictate educational content or form, it simply allows the teacher / instructional designer flexibility in creating / conducting virtual presentations.

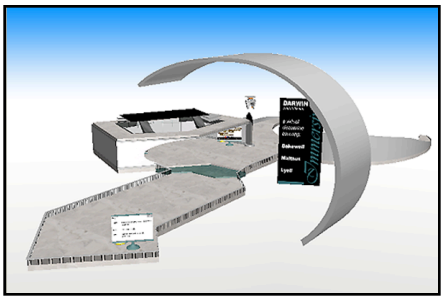


Figure 1: An Overview of Bespace

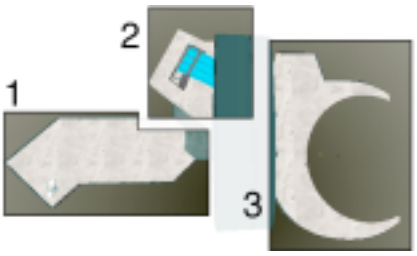


Figure 2: Three Functional Areas

Bespace Divided

1) *The Landing Area*, the entry point into the lecture hall and an open space for student social interaction.

2) *Class Storage*, holds course information and provides notes on lectures. Currently contains two digital kiosks.

3) *The Presentation Ring,* the primary lecture space. The teacher floats in the middle, shape-shifting into 2D slides, 3D models, and small 3D environments. It also acts as a staging area / portal into larger 3D environments. Students generally stand on the edge of the ring, unless asked to explore a 3D environment.

Figure 3: A student walks to class

A SPECIAL TEACHER

Figure 4: A series of images showing the teacher's quick initial transition from faux humanoid form into a 2D title slide with rotating background panorama.

Figure 5: Advancing like a PowerPoint presentation, the teacher shape-shifts into a series of slides. Above, an image highlighting the "English Enclosure Movement" which inspired Bakewell and Mathlus.

Figure 6: At the end of each subsection in the Darwin lecture, the teacher returns to human form and addresses broader student thoughts or questions.

Teacher as Series of 3D Models / 3D Worlds

In addition to 2D slides, the teacher shape-shifts into 3D models and small 3D worlds. In the Darwin lecture, this is often done in a series. Simple models are replaced with similar but more complex models. Background panoramas are added to address issues of cultural content. In some cases, 2D slides transition into 3D worlds.

Interactive behaviors, ones tied to the individual models, are generally unshared. Each student gets to manipulate and explore the individual models in their own way. (2D slide also have unshared billboard behaviors so that they always face individual students)

Figure 7: From the section on Bakewell, beef and cattle breeding: the teacher's avatar as cow. The buttons below the cow allow students to see a "meat view" of the animal. This model leads to a discussion on economics and English culture.

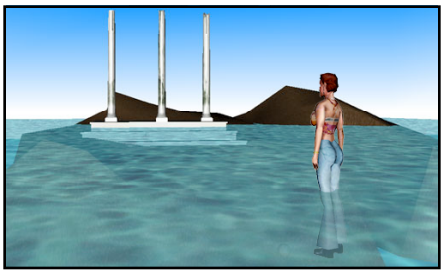
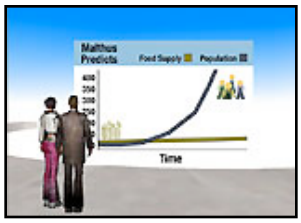


Figure 8: From the section on Lyell and geology, teacher as small explorable 3D world (presented within the ring) The model is the Temple of Serapis, which Lyell used to prove a theory of gradual geological change. Students are asked to gather information and discover how Lyell accomplished this.

Figure 9: From the section on Lyell and geology, teacher as interactive rock strata. Students are asked to explore the model and explain the changes in the fossil record and address the issue of extinction in a religious context.



Figures 10 & 11: From Malthus and survival of the fittest, teacher as slide and world. To highlight the population concerns of Malthus and English society, The 2D chart of Mathus's equations rotates beneath the feet of the students and hordes of poor emerge as he predicted.

THEORY

The design choices and HCI considerations of Bespace run an interesting balance between the forces of realism and those of reality. One example is the initial walk to class. Given the digital nature of the space, it is possible to have the system automatically place students directly in the presentation ring. From a GOMs perspective, direct placement is a more efficient method of positioning students than walking, yet walking to class has value. Walking to class, the idea of free travel over a short distance, was felt to add a sense of immersion, social presence and opportunities for social interaction. Granted, this balance is guesswork, but the underlying utilization of the digital reality of virtual space blended with the attempt at applying behavioral mechanisms generated by realism seems worthwhile.

Figure 12 & 13: The left image is from HorizonLive, a synchronous 2D educational software package. While HorizonLive effectively delivers a slideshow of 2D educational content, social presence is not visually reinforced. With avatars positioned, aspects of student behavior, like raising hands to ask a question can be explored. The 3D space also appears to foreshadow / support the use of educational 3D models and worlds during the lecture.

Bespace's HCI goals are the flexible presentation of information, the management of cognitive load and ease of user interaction. Bespace does not dictate content, it provides new options for designers. Options include screen filling 2D slides, interactive 3D models (presented in series to ease complexity), background panoramas (for context), small focused 3D worlds, or using the ring as briefing space linked to larger, fictional worlds or simulations.

In support of user interaction, the principles and the digital realities that guide the development of 2D interfaces also are in place within Bespace. Some of the principles are: [3]

- Minimize the number of navigation steps needed by users to accomplish their tasks.
- Avoid unnecessary visual clutter that distracts from or inhibits user tasks.
- Simplify object movement; use predictable paths and less than 6DOF
- Organize groups of items into aligned structures for easier access.

Groundless and Uncluttered

Removal of the ground plane beneath the teacher was a step away from realism in favor of more flexible presentations and better management of cognitive load. From a visual perspective, the ground plane takes up valuable space on the computer screen. The slides and models of Bespace would have almost their entire bottom halves cut-off or be forced to be made smaller to fit with a flat ground plane. Small worlds would be forced to share the ground.

Alternative, realism-based, approaches such as stadium seating or simply asking students to look up at larger models are possible, but hold interactive drawbacks. Looking up is not simply an extra step; it forces the viewer to see the bottom of the model and limits views of the top. In contrast, Bespace centers large models in front of the students. Granted, stadium seating would allow for centered models and provide the teacher with a pleasing place to stand, but in Bespace, the teacher shape-shifts into the presentation, so the value of a place for the teacher to stand seems questionable. In the end, the ground plane in the presentation is seen as *unnecessary visual clutter that* interferes with the presentation of slides, models, worlds, and the use of panoramic backgrounds

The charge of *unnecessary visual clutter* is again made with the teacher's avatar. Holding the human avatar and educational content on screen consumes valuable visual real-estate. If too close, the teacher's body will cover / conflict with the 2D slide or 3D model. If the teacher is set to the side, travel by the teacher on and off stage becomes a real and burdensome *navigational task.*

For students, the value of the teacher's human form avatar is largely in the visual reinforcement of social presence. Its eyes, hands, legs are representational rather than functional. Being representational it conveys information through gestural expression. Bespace simply modifies gestures into a mode better suited to mouse and keyboard – a PowerPoint presentation. Combining teacher with content is clearly efficient. The real question, answerable by user testing, is to what extent does this disrupt presence and immersion?

A PRELIMINARY USABLITY STUDY

20 Juniors in the Simulation, Design and Entertainment (SDE) program at the University of Baltimore were given class time to participate in a preliminary evaluation of Bespace. Students were broken into 4 groups of 5 and taught the *Darwin a Man and His Times* as a live lecture. Results stem from a questionnaire (short answer, true-false, 5 point Likert questions) and group discussions afterwards. Unfortunately for data analysis, the screener showed that nearly all students had prior online learning experience and played videogames on a weekly basis. Therefore, Likert data is presented without consideration for subgroups.

Immersiveness and the impact of the shape-shifting teacher is one outstanding issue addressed by the study:

Changing the teacher's body was confusing	0%
Changing the teacher's body was unnecessary	15%
Teacher felt present at all times	4.5
Teacher felt present only when I saw their body	1.5
Teacher felt more present when I saw their body	3.5
The space was immersive	2.6

During the group discussion, an unexpected factor emerged as a leading supporter of teacher presence – VoIP. Hearing the teacher's voice throughout the shape-shifting lecture and having the teacher respond in real-time to questions appears to effectively reinforce teacher presence.

A second reason for teacher presence arising from students is harder to describe. In general, students felt they had already been exposed to this type of digital interaction and Bespace was merely a step along a path. Students discussed videogames and their use of shape-shifting characters. A few noted mythology, science fiction and comic books as references for shape-shifting. Others considered that the PowerPoint metaphor is nothing new. There was also a broad discussion on how communication tools like Instant Messaging (IM) and cell phones connect people without visual support. Granted, the student's digital design backgrounds did seem come into play. Also then, like many of young Americans, they are individuals born into a digital world and raised on the internet, their expectations of reality are perhaps more flexible than previous generations.

One theoretical explanation for Bespace maintaining teacher presence is hidden in the previous paragraph. Some scholars believe that celebrating the affordances of the media breaks presence and immersion [4]. Bespace, however, does not pretend to simulate a fictional world. Teacher and students are not role playing. Therefore shape-shifting does not unsuspend the belief in the teacher as the students are only asked to believe that the teacher is using their avatar to communicate and share knowledge. Like IM, students understood that a real person was present.

Perhaps the initial human form teacher was enough to introduce the students to the idea of the virtual lecture. It became a departure point from which magical shape-shifting could reasonably occur. Once again this is guesswork, but the preliminary results appear supportive.

The low, almost neutral level, of immersiveness was explained by students by poor 3D modeling. Asked about improving immersion, students noted that in future they would become more comfortable, interaction would be easier and that this might influence immersion. From the theoretical perspective, Bespace's lack of fiction may also be a factor.

General Views & Preferences

Understanding the space was easy	4.5
Following along with the instructor was easy	4.8
I would discard the shape-shifting teacher and use only large virtual stories and games	1.5
An educational game would've taught me more	2.3
An educational game would be more engaging	3.2
Would be a useful part of a larger online course	4.9
I want a mix of Bespace and games	3.6

SDE students have considerable experience building and being taught through educational games. They see potential with games, but feel it has yet to materialize. In contrast, traditional instructor led methodology within Bespace seemed to resonate. Several students offered suggestions to increase the instructor's power in the space and where to place limits on student behavior.

Issues & problems

Two issues were raised by students. One was to review the lecture in progress, to go back or forward on their on terms. They suggested a separate pop up window. The second issue was for more exploration and student led interaction. On the surface this appears to conflict with the instruction led methodology, but proper management of a classroom does not equate to removing opportunities for student led learning. This second issue was also tempered by their realizing this was also their first class in Bespace and that more complexity was possible.

CONCLUSIONS

Bespace, as an exploration of digital world design, opens a window into a conflict between realism and reality. As digital worlds separate themselves from games and simulations new native forms will emerge. Whether Bespace is correct or not, it's underlying concerns of realism / reality, interface / environment, human avatar / informational node ought to be addressed. To review these assertions, an older, single user demo space is here:

http://bespace.lcc.gatech.edu/single/

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