A Metaphor for Immersive Environments: Learning Experience Design Challenges and Opportunities

Elaine M. Raybourn
Sandia National Labs* / ADL
Orlando, FL
emraybo@sandia.gov, elaine.raybourn@adlnet.gov

ABSTRACT

Learning experience design (LX) is a subset of user experience design (UX) that addresses the synthesis of learning sciences, human-computer interaction, and design thinking. Learning experience design puts the learner at the center of the design process. As the MODSIM community increasingly develops more immersive simulations and persistent experiences with virtual/mixed/augmented/synthetic realities, it may be useful to employ a metaphor to guide design and bring to the fore initial assumptions, biases, or expectations that may make their way into the design of learning experiences for military end users. Therefore the present paper utilizes the interactive storytelling metaphor of the *Star Trek Next Generation* holodeck to guide learning experience design and serve as a widely recognizable cultural metaphor. This perspective provides a basis for elaborating the holodeck metaphor in ways that may be relevant to identify challenges and opportunities for developers of virtual/mixed/augmented/synthetic realities. The present paper introduces the notion of the social construction of narrative, describes a framework for simulation experience design, and presents some challenges and opportunities that may impact the design of learning experiences in immersive simulation environments.

ABOUT THE AUTHOR

Elaine Raybourn, Ph.D. is a Principal Member of the Technical Staff in the Cognitive Science & Systems group at Sandia National Laboratories' Center for Computing Research. She is an ERCIM (European Research Consortium in Informatics and Mathematics) Fellow and has worked in research laboratories in Germany, England, and France. Elaine speaks regularly on the topics of games, transmedia learning, and next generation learning ecosystems. She serves on several international journal advisory and editorial boards including *Interactive Technology and Smart Education*, *Journal of Game-based Learning*, and *Simulation & Gaming*. She is on assignment to the Advanced Distributed Learning Initiative, Office of the Deputy Assistant Secretary of Defense (Readiness) where she explores the future of learning science & technology, and fuels her passion for the design of intelligent, culturally aware, transmedia storytelling & learning ecosystems.

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INTRODUCTION

> "Even before Star Trek and Holodecks I'd read books that had this idea of people being able to go into virtual reality systems…It's exciting to me that we're getting to that point now, being able to blend the real world and the virtual world increasingly seamlessly, much as the movie visual effects people have been able to do. We'll be able to do that in real time in everybody's home." *Noah Falstein, Google Chief Game Designer, at Quo Vadis Game Developers Conference, May, 2015.*

The physical world around us is well known to most of us, we spent our early years learning about space, mass, movement, and direction. We often take space for granted so much that it comprises the framework of our way of speaking (Lakoff & Johnson, 1980). A user's familiarity with real spaces makes designing virtual spaces problematic. Our innate sense of spatial orientation in the real word is undermined by cumbersome technology and the use of input/output devices when engaging in immersive, virtual environments. That said the future looks bright—trends in games, virtual/mixed reality, robotics, and artificial intelligence promise to bring us closer to rich, technology-mediated experiences popularized by science fiction (Bilton, 2014).

Designers and developers of technologies often cite popular culture and science fiction as sources of inspiration. For example, Gene Roddenberry's *Star Trek* series—popularized by American media and Hollywood—has been a cult phenomenon in the United States celebrated for decades by scientists, artists, and technologists alike. Audiences around the world have been intrigued by the potential of Star Trek "technologies" to change our society, relationships, and abilities. The *holodeck*, first introduced in the television series *Star Trek Next Generation* in 1987*,* has widely influenced discussions about the design and use of immersive, computationally augmented collaboration environments. A holodeck is a smart virtual/architectural hybrid space that incorporates voice actuated computer interaction, artificial intelligence, and holographic display of information. Holodeck simulations can be distinguished from reality only by their limitless programmability. The *Star Trek Next Generation* holodeck was the epitome of an interactive storyworld of illusions that could be stopped, started, redirected, recombined, and reused at will (Murray, 1997). The holodeck is in fact "too good to be true."

Behind the holodeck were some highly paid Hollywood scriptwriters expert at narrative and timing. By design, the holodeck was created to stretch audience imaginations beyond their boundaries of the physically familiar and technologically possible. Usability was seamless and the technology transparent in the *Star Trek Next Generation* holodeck. Unfortunately, more traditional computational environments have not been particularly successful at achieving the high technical ideals set by literally adopting a holodeck metaphor.

Nevertheless, the notion of the holodeck can be useful when applied in the socio-technical context of general user and learner expectations. The holodeck introduced audiences to possible social implications of futuristic non-traditional human-computer interfaces for learning and collaboration. For example, by immersing oneself in the holodeck environment, crewmembers simulated problem situations, evaluated alternative solutions, employed new tools, and painlessly explored the consequences of life-altering decisions. The holodeck induced provocative changes in the behaviors of the crew of the *Starship Enterprise* while exploring what the future could hold for human communication and creativity. In fact, the holodeck technology was so seamless, it was practically invisible. That is to say, it was not necessarily the pointer to futuristic technologies of the holodeck that inspired audiences around the globe, but rather the narratives, or stories, *created in it*.

Although the holodeck is a powerful metaphor for the way computer simulations, artificial intelligence, and advanced information displays can augment human learning and collaboration, like any metaphor, it must be interpreted with care. What aspects of the holodeck are most important to learning through discovery or collaborative problem solving? Possibilities from which we might have chosen include the availability of real time simulations; practically unlimited access to information, bandwidth, and artificially intelligent collaborators; and the freeing of computational power from the encumbrances of screens, touchpads, keyboards, mice, and other devices.

More importantly, however, in the present paper the holodeck metaphor is extended to illustrate how we may presently achieve some of the *qualities* of this imaginary computationally augmented environment in order to support real life, face-to-face and virtual human learning, collaboration, and digital storytelling that is information-rich, *right now*. The present paper begins with a brief description of the holodeck metaphor as a device to explore how learning experience design is a social construction of narrative. Second, the Simulation Experience Design Framework (Raybourn, 2007) is introduced to organize key concepts relevant to designing learning experiences in immersive environments and their associated challenges and opportunities. The notion of carefully blending both real and virtual spaces to achieve total immersion in learning experiences is discussed. Last, the conclusions describe a solution space that is neither high-tech nor low-tech, but all-tech. As previously noted by the author (Raybourn 2013, 2014), the challenge facing contemporary software designers is to map 21st Century technology and experiences with media into the human storytelling process, and implement it in a way that is practical, robust, and usable.

LEARNING EXPERIENCE DESIGN AS A SOCIAL CONSTRUCTION OF NARRATIVE

The meaning of any metaphor emerges from an interaction between the metaphor's basis (in this case, the holodeck) and the goals, assumptions and constraints of its interpreters. In applying the holodeck metaphor to the design of a collaborative learning environment, the author's interpretive bias is to de-emphasize the advanced technologies it describes in favor of the collaborative learning it potentially supports. One of the dangers of the holodeck metaphor is that it might steer us toward trying to replicate *Star Trek* technology, while ignoring practicality, usability, human performance, learning, and the deeper structure of human collaborative work or play. This could easily lead to the construction of yet another technical showpiece, filled with costly, soon to be obsolete, hardware that is good for little more than carefully orchestrated demonstrations. If we are to build a useful collaborative learning environment, the human dimension must drive our design decisions.

"Social construction of narrative" is the creation, by a group of people, of systematic, coherent structures for organizing shared knowledge and developing future knowledge. Although the goal of social construction of narrative is applicable to nearly all forms of collaborative information work, the emphasis on narrative as a social construction is particularly relevant to the design of learning experiences. Learning experience design (LX) is a subset of user experience design (UX) that addresses the synthesis of learning sciences, human-computer interaction, and design thinking. Learning experience design puts the learner at the center of the product or service design process. As the modeling & simulation community develops more immersive simulations and persistent transmedia learning (Raybourn, 2014) experiences with virtual/mixed/augmented realities, it can be useful to employ a metaphor to bring to the fore initial assumptions, biases, or notions of expectations integral to the design of learning experiences for military end users.

Narrative plays a powerful role in virtually all forms of human problem solving, theory formation, creative work, and play (Raybourn & Waern, 2004). For example, examining seminal work in artificial intelligence has long recognized the power of scripts and other narrative structures in creating and organizing knowledge (Schank & Abelson, 1977; Schank & Morson, 1995). Laurel (1991) has shown that human computer interfaces can be improved by paying attention to the narrative structure of the interaction activity. Narrative has even been shown to underlie the formation of scientific theory. Historical studies of scientific practice confirm the role of metaphor and analogy in theory formation (Hesse, 1966); these processes derive their power from their narrative-like ability to organize knowledge into a systematic structure. Landau (1993) offers further support for the role of narrative in science by analyzing various versions of the theory of evolution, to show that all of them have a common narrative structure that mirrors the universal hero myth.

Therefore, the position taken in the present paper is that it is not the promise of technology that ultimately appeals to users; it is idea of co-creating and living out stories. More than the promise of artificial intelligence, simulation, or

visualization, it is the support for social narrative construction and creativity that is the source of the metaphor's power. This understanding gives us a basis for elaborating the holodeck metaphor in ways that may be relevant to the designers and developers of immersive learning experiences.

SIMULATION EXPERIENCE DESIGN FRAMEWORK

Militaries, like most organizations, tell stories to convey learning, strategies, and knowledge. Operations, campaigns, and intelligence analysis are story-driven endeavors. Scenario and problem-based training with simulations, in particular, often leverage story-driven experiential learning. The Simulation Experience Design methodology and framework (Raybourn, 2007) is a process that addresses the design of learning as a system of experiences that exists within an emergent, adaptive cultural context that the designer strives to engender throughout engagement, as well as before, between, and after formal learning has concluded. The word simulation in the name of the method refers to an experience in which the role of a human, environment, or both, can be simulated. The Simulation Experience Design methodology, briefly described in the present paper, has been applied by the author and others to serious game design (Raybourn, 2007; Bergin-Hill et al., 2014), and transmedia learning (Raybourn, 2014). Whether UX or LX, experience design solutions require that designers understand what makes a good experience first, and then translate these principles, as efficiently as possible, into the desired medium without the technology dictating the form of the experience. In simulated environments in which learners are creatively problem solving together, one's experience may be unpredictable, may not have a right or wrong approach, or may not be what the designer intended. Simulation Experience Design can be helpful in framing the co-creation of problem-solving opportunities as an open-ended, rich *system of experiences* that fosters learning.

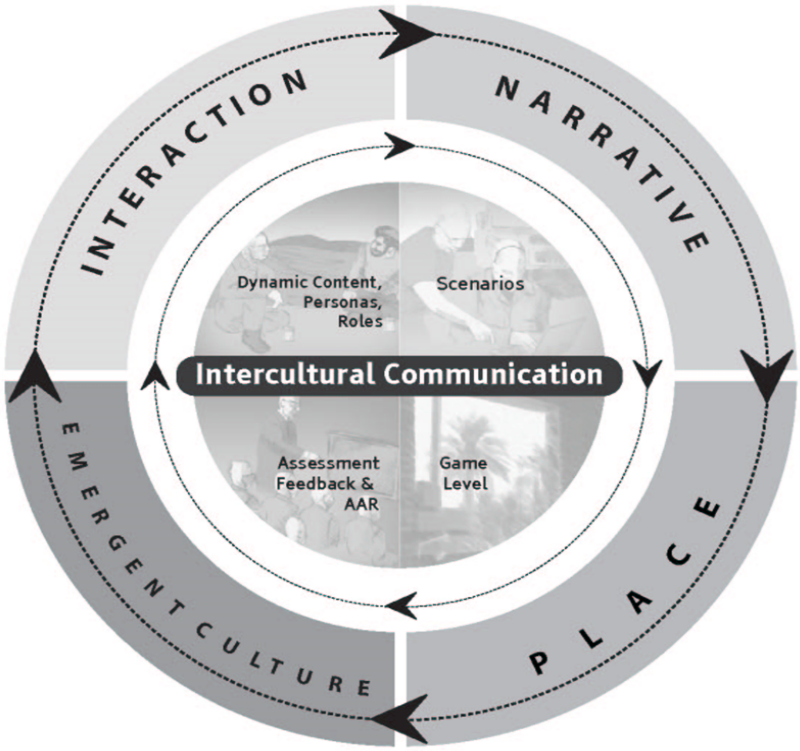

Figure 1. Simulation Experience Design Framework (Raybourn, 2007)

The Simulation Experience Design Method suggests that supporting equitable intercultural communication and learning is comprised of several salient elements, among them 1) the *interactions* or type of communication (interpersonal, group, etc.), 2) the *narratives* that are co-created by interlocutors, 3) the *place*, or context, in which narratives occur, and 4) the *culture that emerges* from the social construction of experience (Laurel, 1991). Following the circular framework from upper left to upper right, design tasks may then be considered as facilitating

a journey, or connected learning experience from interactions to emergent culture that iteratively lead to new interactions spawned by the emergent culture. Use of the framework is intended to improve the quality of equitable intercultural communication and learning in collaborative, immersive environments such as serious games, simulations, and transmedia storytelling & learning ecosystems (Raybourn, 2007, 2014; Bergin-Hill et al., 2014).

Finally, by treating intercultural communication as a *core value*, the individual cultural backgrounds the players bring to their experiences are considered strengths, not design liabilities. As we strive to create engaging immersive experiences approaching the holodeck, differing cultural values of designers, developers, stakeholders, and players can create a myriad of complications and competing desires or expectations. Simulation Experience Design can serve to socially construct narratives and establish a shared understanding for thoughtful analysis from which to better ground assessment and evaluation of human performance, creativity, and expertise.

APPROACHING THE HOLODECK—CHALLENGES AND OPPORTUNITIES FOR LEARNER EXPERIENCE DESIGN

The following sections describe some of the challenges and opportunities that are "low hanging fruit" with respect to LX for immersive environments. The challenges and opportunities are presented below as they apply to each of the elements of the Simulation Experience Design framework. The benefit of using the holodeck as a learning experience design metaphor is that it allows designers and developers to focus on the essence of interactions in the holodeck, not necessarily the specific technologies.

Interaction

Challenge: The communication space

After the novelty has worn off, Virtual environments are usually less interesting *and* less appealing to the senses than the real world. What can we do to make spaces more appealing to the senses and more easily inhabitable? We know that people can make spaces more interesting, and, conversely, empty spaces may be prone to bore learners—how can we make use of the emptiness often associated with virtual environments?

Opportunity: Support quiet reflection and active immersion

An immersive environment can encourage an appropriate mixing of virtual and co-present learners for public, private (alone or two), and semi-private (small group) interactions. Although we often equate immersion with activity, designing for quiet reflection can enhance a learning experience. The holodeck allowed for active and reflective behavior, both physically and virtually. The "coordinated use of mind, language, and body is a fulfilling mode of being in the world" (Penn et al., 1999; p. 193). A space that is experienced through reflection and action will enhance the immersion and engagement of the space. Supporting this immersion requires we be able to represent the emerging narrative (e.g., problem solution) in the shared physical space. For example, learners may want to actively manipulate data, or quietly inhabit the same physical or virtual space while working side-by-side with colleagues. This suggests a judicious integration of both high-tech (wall-size displays for data simulations and shared virtual spaces) and low-tech (chalk boards and butcher paper) representations. Telepresent creativity should also value the silent pauses between verbal communication as much as it values the communication itself. Proximity creates presence without constant communication. The telepresent space must, like the holodeck, support co-present reflection as much as co-present active communication.

Narrative

Challenge: The storytelling space

Although we think of immersion as a property of advanced computer interface technology, immersion is actually a fundamental property of narratives that goes back earlier than Homer. All good stories can draw us in to the virtual worlds they create. How can we facilitate the simultaneous co-creation of and immersion in a shared narrative?

Opportunity: Achieve co-created immersion *with* and *through* interactivity

The medium of film has deeply immersive qualities, and is both symbolic *and* spatial. Movies achieve immersion through fixed narrative, the representation of physical space and realistic audio, yet are also symbolic in that the viewer sees from a "Gods eye" view. Movies compress time to suit one's limited attention span and warp psychological and physical distances to suit narrative flow. A film is not a "true" representation of reality, but it is

compelling nonetheless. However, to explore the notion of *the viewer as a co-creator of narrative* we may look at how computer game technology achieves immersion *with* and *through* interactivity. Early pioneers like Brenda Laurel and Hal Barwood pointed out that computer games are more like plays, not films (Card, 1991; Laurel, 1991). Like plays, scenes in computer games are often viewed from single angles and from the same distance. Additionally, as actors leave the stage, audience members know that they still exist and are not out of the context of the plot. A computer game is similar in that the player buys into a narrative of off-screen armies plotting against him or her while s/he is battling evil aliens on-screen. Thus, the action of the game takes place on and off the screen (Laurel, 1999). Games are stories that are co-created by the player (Murray, 1997).

Our goal, as learning experience designers of an immersive information space, is to combine the symbolic narratives of movies and the co-creating nature of games into a space that support flexible creative relationships and improvisation that characterize learning and human creative problem solving. Previous research points to real spaces that support creativity and innovation (Penn et al., 1999), and the way problem solvers use objects as part of the creative process (Smyth, 1998). Narratives often find their way into physical spaces—via storytelling artifacts and other attempts to capture an experience in a more permanent fashion. An immersive, information-rich problem space should provide for the spatializing of narratives and artifacts necessary to facilitate innovation and creativity.

Place

Challenge: The space isn't a place

An immersive information space is not just a display of data; it should be a *place* where people act.

Opportunity: Achieve immersion with contextual cues

Learning is situated in implicit cultural and contextual information. This includes assumptions, values, goals, meanings, and history shared by learners. This information is often implicit, and comprises the tacit knowledge that is learned through interactions over time. When collaborating with learners, especially those who are not co-located, we should attempt to include tacit knowledge in our computational space, although much essential tacit knowledge never successfully makes it into current computational environments. The present author (Raybourn et al., 2003) has shown that introducing subtle cultural and contextual cues into immersive environments is an effective way to encourage certain group collaboration. Experience designers can accommodate learners' need for cultural information through a deep understanding of social work structures, careful application of intercultural communication principles, and a willingness to accept the possibility that when faced with a choice, learners may recognize that some activities happen outside the immersive environment.

Emergent Culture

Challenge: The space for diversity

Simulation technology has a tendency to present a single point of view so powerfully, and with such an illusion of reality, that other points of view are lost. One of the less fortunate effects of information and communication media is their tendency to homogenize different points of view. How can we ensure that learning in collaborative immersive environments celebrate creative differences and reward out-of-the-box thinking?

Opportunity: Support multiple points of view and perceptions in multiple spaces

In parallel with our growing acceptance of virtual spaces, we can begin to explore merging a spatial and symbolic paradigm. A space that is populated with intelligent agents may adapt to one's perspective, cognitive perception, and indeed crucially, to specific communities and communication preferences. The *medium* may be *the message*, but we should also remember that in designing message-rich environments, the message is more important than the medium! We can use agents to tailor information and personalize the medium based on an understanding of the way learners perceive information, the narratives they co-create, and knowledge of how users juggle peripheral and focused information in multiple spaces.

CONCLUSION

We have captured what we believe to be the essential appeal of the holodeck metaphor, and also the essential constraint on the physical/virtual environment we hope to construct. Recall that it is not the technology that appeals to users; it is idea of creating and living out stories with colleagues. This understanding provides a basis for elaborating the holodeck metaphor in ways that may be relevant to the modeling and simulation community.

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