Simulation Experience Design Methods for Training the Forces to Think Adaptively

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ABSTRACT

The present paper discusses the Simulation Experience Design Method employed to create engaging learning environments for training U.S. Armed Forces to think adaptively. This design method is based on the notion that one's total experience in the simulated environment, or crucible, is integral to the learning process. A "crucible" experience is a defining moment that unleashes abilities, forces crucial choices, and sharpens focus. Simulation Experience Design lies in purposefully weaving players' interactions with all entities and variables in the simulation game environment in order to guide certain communication events to occur. The system of interactions executed in the simulation game guides players to experience the *effects* or *consequences* of behaving, responding, thinking, identifying, acting, and feeling in certain ways.

The Simulation Experience Design Method focuses on creating problem-solving opportunities in open-ended, culturally relevant environments in which users build awareness of the problem domain, internalize strategic thinking and hypothesis building, discover their strengths and weaknesses, develop intercultural communication skills, and hone the perceptual sensitivity to confidently navigate complex phenomena.

The examples referred to in this paper reflect a unique twist on the first-person shooter game engine that is nonviolent and adapted to train communication and interpersonal rapport building skills. In effect, a first-person shooter engine can be used to train non-kinetic engagements.

Currently an instantiation of an adaptive training system employing the Simulation Experience Design Method is in use and a part of the curriculum at Ft. Bragg. The present paper discusses the Simulation Experience Design method used to design adaptive training systems—from the design of scenarios executed in a virtual environment and in-game assessments of observer controllers to facilitating community-based learning during after action reviews.

ABOUT THE AUTHOR

Elaine M. Raybourn, Ph.D. in intercultural communication with an emphasis on human-computer interaction brings an expertise in understanding culture and communication to the design of serious games & experiential simulations, adaptive training systems, and context-aware groupware. Her research and design concern topics such as cultural awareness, real-time in-game assessment, novel after action review (AAR) systems, creative collaboration, and designing learning applications that stimulate cross-cultural communication, intercultural awareness, and cognitive & metacognitive agility (adaptive thinking). Elaine was an ERCIM (European Consortium for Research in Informatics and Mathematics) 2002-04 Fellow, and is a principal member of Sandia National Laboratories and a National Laboratory Professor at the University of New Mexico's Department of Communication & Journalism, Institute for Organizational Communication.

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INTRODUCTION

In recent years, there has been an increased emphasis on developing adaptive, self-aware military leaders. One such game-based, experiential training system that focuses on developing adaptability, self-awareness, and leadership was developed in 2003-2004 (Raybourn 2005a; Raybourn et. al., 2005b). An important element of the game-based training approach intended especially to hone trainee adaptability and self-awareness is the purposeful design of a "crucible" experience. A crucible experience is "…a defining moment that unleashes abilities, forces crucial choices, and sharpens focus. It teaches a person who he or she is." (Bennis & Thomas, 2002; p.16; Wong, 2004). The crucible experiences designed by the author encourage trainees to exercise adaptive, critical thinking and effective communication skills in open-ended learning environments that do not necessarily favor a particular right or wrong answer, or preferred procedure.

The present paper introduces the social-process Simulation Experience Design method employed by the author to create engaging game-based crucible experiences for training individual and teams to interact and communicate more purposefully and think more adaptively. Adaptive thinking is defined as possessing competencies such as negotiation and consensus building skills, the ability to communicate effectively, analyze ambiguous situations, be self-aware, think innovatively and critically, and exercise creative problem solving skills. In the present paper a social-process simulation is defined as an environment that is used to replicate behavioral processes that usually employ a human in a role-playing situation (Gredler, 1992). Social-process simulations focus on human interactions and communication in the pursuit of social goals. One instantiation of the Simulation Experience Design method has been an adaptive thinking and leadership game-based training system which has been in use at the JFK Special Warfare Center and School for the past 2 ½ years (Raybourn et. al., 2005b). A full description, preliminary self-assessment of learning, and user feedback on the training scenarios is provided in the 2005 I/ITSEC

paper and is therefore not discussed here. These methods are also being employed in a second instantiation of adaptive training systems that is currently under development. In the present paper, the focus is on a serious game design method for creating crucible experiences for adaptive training systems— from the design of scenarios executed in a virtual environment and in-game assessments of observer controllers to facilitating community-based learning during after action reviews. In each case, the Simulation Experience Design method is employed to create an immersive communication environment. Subsequent sections of the present paper explain how the Simulation Experience Design method can set up the context for experiential learning in crucible environments through 1) social-process simulation characteristics and 2) "designing from the interaction out." The Designing from the Interaction Out' framework (Raybourn, 1999, 2004) has been used for designing multiplayer games, non-kinetic engagement training, collaborative virtual environments, and social-process simulations that treat intercultural communication and cross-cultural discovery as core interaction goals. A short description and structural examples from an adaptive, critical thinking, leadership training system that was designed with these methods is provided.

Adaptive Training System Description

Simulation Experience Design methods have been used to create a number of collaborative systems (Raybourn 2001; 2003a) including the non-kinetic engagement and leadership training system mentioned earlier (Raybourn et. al., 2005b). The composite description below of the leadership training system and non-kinetic engagement training system is presented here as an example of how the crucible experience can be instantiated in a software framework. This is just one example—a crucible experience need not be instantiated exactly this way in every training system. As mentioned before, the most important step is to determine what makes a good experience for the target audience.

The game-based design of the adaptive training system for non-kinetic engagements consists of a scripted single-player and a non-scripted immersive multiplayer environment for classroom use which leverages commercial computer game technology (i.e. Unreal Tournament & Army Game Platform, Operation Flashpoint & DARWARS Ambush!). The platform supports up to 32 roles at a time (includes instructor, role-players, and observer controllers). Role-play is centered on exercising critical thinking, building interpersonal rapport, and developing negotiation skills in different scenarios. Role-players use headsets with microphones to communicate and interact with others during gameplay. Both private team communications channels and public channels are available for instructors and role-players. Role-players voices can be masked to preserve anonymity. Role-players have different objectives and roles that are often in conflict with each other. Through communicating with others, each trainee learns to strategically interact with others, notice cues in the environment, and exhibit leadership skills in ambiguous or ill-defined situations often involving ethics, planning, safety, conflict mediation and intercultural communication. Instructors also create dynamic content/actions for scenarios in real-time or a priori through an authoring interface. Real-time introduction of content that influences the actions taken by role players in the scenario helps the instructor create opportunities for adaptive thinking and demonstration in leadership skills as the situation dynamically chances. The training system design also includes a Sandia proprietary method of capturing real-time in-game assessment and feedback from observer controllers, subject matter experts, or peer learners. Statistical analyses are performed on the assessments and displayed from the after action review system. Instantiating real-time assessments into the training tasks build metacognitive skills such as analyzing and assessing decision making processes. Finally, the virtual after-action review allows for bookmarks, replay of events, frequency statistics on actions taken, and the display of real-time assessments, bullet tracking, and snail trails. Actions logged by the computer-based training system are then referred to during the after action debriefing.

SIMULATION EXPERIENCE DESIGN METHOD

The Simulation Experience Design methodology advanced by the author for the design of games, social-process simulations, and other collaborative technologies (1999; 2001; 2003a,b; 2004) is based on human-computer interaction (HCI) experience design principles that have been modified for the design of serious games and other highly interactive environments. HCI experience design solutions require that designers understand what makes a good experience first, and then translate these principles, as well as possible, into the desired medium without the technology dictating the form of the experience. Experience designers strive to create desired perceptions, cognition, and behavior among users, customers, visitors, or the audience. Simulation Experience Design is employed in the design of the entire training system, from the design of scenarios, roles, novel assessment interfaces, and after action reviews. This design method is based on the notion that the one's total experience in the simulated environment, or crucible, is integral to the learning process. According to Bennis & Thomas (2002; p.93):

> People with ample adaptive capacity may struggle in the crucibles they encounter, but they don't become stuck in or defined by them. They learn important lessons, including new skills that allow them to move on to new levels of achievement and new levels of learning. This ongoing process of challenge, adaptation, and learning prepares the individual for the next crucible, where the process is repeated. Whenever significant new problems are encountered and dealt with adaptively, new levels of competence are achieved, better preparing the individual for the next challenge.

As designers of educational environments supporting crucible experiences, our goal is to create dynamic, changing situations that challenge and prepare trainees for the next crucible they will encounter, and so on. Simulation Experience Design lies in purposefully weaving players' interactions with all entities and variables in the game environment in order to create crucibles that guide certain dynamic actions and communication events. The system of interactions executed in the simulation game guides players to experience the *effects* or *consequences* of behaving, responding, thinking, identifying, acting, and feeling in certain ways. The consistent patterns of our interaction with artifacts, our physical environment, and other individuals over time provide cues that we use to interpret culture, situations, and environments to reduce uncertainty (Raybourn, 2004). One's crucible experience is unpredictable, and has no right or wrong approach. The goal is to guide the trainee in certain directions, and then introduce cognitive, self-reflexive, or social challenges to induce experiential learning. Thus the Simulation Experience Design method focuses on creating problem-solving opportunities in

open-ended, culturally relevant environments in which users build awareness of the problem domain, internalize strategic thinking and hypothesis building, discover their own strengths and weaknesses, develop intercultural communication skills, and hone the perceptual sensitivity to confidently navigate complex phenomena (Raybourn 2005).

Social-Process Simulation Characteristics Common to Designing Crucible Experiences

Simulations are sophisticated, interactive, role-play exercises that are popular in education and training at various levels and include such areas as tactical decision-making (data management, crisis management) and social-process (language skills, communication, empathy, and social systems simulations). In the social sciences a social-process simulation is an environment that is used to replicate behavioral processes that usually employ a human in a role-playing situation. Modern interest in social-process simulations and role-playing can be traced to the work of Lewin (1951) and Piaget (1972). According to Vincent and Shepherd (1998),

> Both [Lewin and Piaget] argued that effective learning occurred when there was a sustained interaction between the learner and the environment and when there was an opportunity via social interaction to reflect on the experiences in that environment. Piaget (1972) also stressed the importance of social interaction in providing stimulus for challenging existing beliefs, as a first step in changing those beliefs.

A social-process simulation focuses on various human interactions involved in pursuing social or political goals. As trainees function in their role-play, they may experience frustration, pride, rejection, acceptance, cooperation, conflict, anger or other emotions. Therefore, one important component of social-process simulations is to explore the origins of emotional reactions and their relationships to the larger sphere of human experience and its impact on decision making.

Another important component of social-process simulation design is to challenge existing beliefs. The designer's task is to get trainees to interact, take actions that affect others implicit assumptions and create cognitive dissonance or conflict among participants' goals, then guide the participants to develop skills in conflict negotiation, empathy and awareness, etc. Finally, participants successfully arrive

at the learning outcome by monitoring their feedback and the feedback of others (see Table 1).

Table 1. Design Characteristics of Social-Process Simulations (Gredler, 1992)

Task	Focus	Problem	Actions	Feedback
Interact with others to address challenge	Effects of one's own assumption, goals, strategies on action	Arises from conflict in roles, goals or actions	Use of social interaction, i.e. negotiation, persuasion, mediation	Reactions of other participants and self-assessment evoke change

Recall Bennis & Thomas's (2002, p. 16) definition of a crucible experience: "a defining moment that unleashes abilities, forces crucial choices, and sharpens focus. It teaches a person who he or she is." Raising the emotional capital associated with the problem and challenging the trainee to rethink her assumptions as she negotiates with others through a conflict and incorporates the feedback of others into her self-assessment defines the structure of the crucible experience of non-kinetic engagements faced by the military today.

In another example, the author (2001) designed an internet text-based simulation game for university-level adults that supported crucible experiences of identity and power. The design task was to create an interactive environment that guided participants (not moderated) to experience the consequences of behaving and feeling in certain ways. Simulation game participants were not explicitly instructed on how to achieve self-discovery. The results showed that creating an environment rich with cultural cues, interdependent roles, conflict, and the opportunity for reflection guided participants to learn more about themselves and others through social interaction and better prepared them to address challenges associated with understanding identity and power (Raybourn, 2001).

There is no explicit formula for designers on how to create crucible experiences, but by using the Simulation Experience Design method we begin to unpack the concept of "crucible experiences" and identify structures that lead to successful experientially challenging situations. Next we put social-process principles in the Simulation Experience Design framework which is based on earlier work on "Designing from the Interaction Out" (Raybourn 1999, 2004) to complete the design of an entire game-based training system.

Designing from the Interaction Out' Model

A designer once indicated that before seeing the 'Designing from the Interaction Out' model he had often designed virtual environments 'from the technology out'—that is, he usually focused on acquiring the appropriate technological tools that were needed in order to support computer-mediated communication. Sometimes, in the rush to provide system functionality, the social support necessary to motivate users to interact with others is overlooked (Raybourn, et. al., 2003a). Unfortunately, technological supports are not enough for engendering rich communication in multiplayer environments. Trainees must be motivated by narratives, places, and emergent cultures to fully immerse themselves in a crucible experience.
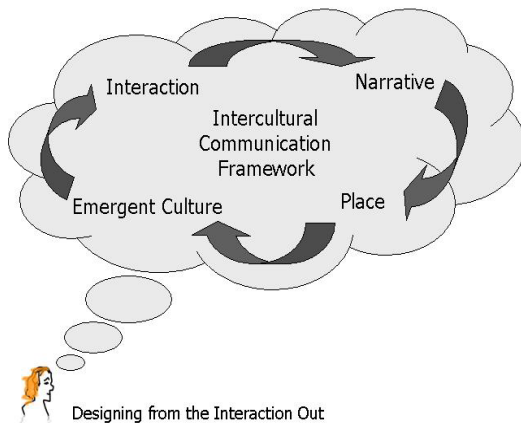

Figure 1. Designing from the Interaction Out

The model in Figure 1 illustrates how through attention to interaction, narrative, place, and emergent culture designers can create dynamic crucible experiences in virtual settings such as serious games, adaptive training systems, and even online communities (Raybourn, 1999, 2004). Intercultural communication competence serves as a core interaction goal which each of the elements support. Intercultural communication is comprised of several salient elements, among them (1) the type of communication, or interaction (interpersonal, group, etc.), (2) the place, or context, in which it occurs, (3) the narratives that are co-created and negotiated by the interlocutors, and (4) the culture that emerges from the communication event. Once a designer has considered the design problem in the context of the cycle from interaction to narrative, to place, to emergent culture—then she begins again, as emergent culture dynamically spawns new interaction events. Supporting intercultural communication thus remains a core interaction goal that designers may

aspire to in the development of more equitable environments that support the emergence of a 'third' culture that neither belongs the interlocutors, nor to the designers-- but instead is a co-creation and artifact of the ongoing dialogue among trainees, designers, adaptive interfaced, and intelligent agents, if applicable (Raybourn, 2004).

SIMULATION EXPERIENCE DESIGN FRAMEWORK

To apply the Simulation Experience Design Method to the design of serious games and crucible experiences, the "Designing from the Interaction Out" model is modified to include the design of dynamic content, personas, roles, scenarios, game level (map) or virtual environment, in-game assessment & feedback, and after action review (Figure 2).
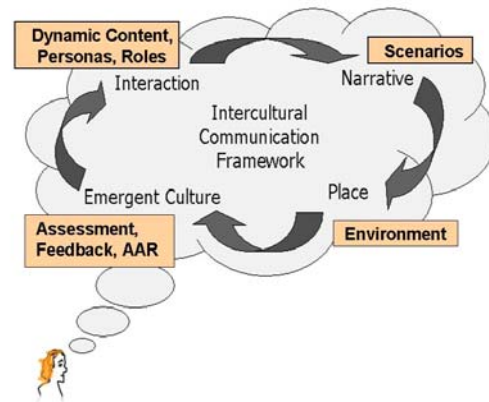

Figure 2. Simulation Experience Design Framework

Interaction

In the interaction phase a designer specifically considers the types of communication instances that she wants to support in her serious game or training system. Roles can be written to tap into trainees' perceived personas and then challenged in a crucible experience. In a multiplayer game setting interactions with others can be guided to occur by introducing dynamic content that is placed in the game scenario either a priori or during game play by the instructor. For instance, to induce trainees playing the role of doctors to consider alternatives in a hospital scenario in which supplies are scarce, medical supplies may be placed by the instructor in a room of the hospital to suggest either stolen, lost, or hidden resources. In the course of the interactions and based on each trainee's role objectives, trainees may then co-create a narrative around the newly discovered supplies. The interaction

events are co-created by the individual trainees and may be different every time as each individual may interpret the same stimuli in different ways. Conversely, one's prior training may suggest typical courses of action—in which case the designer can play off these assumptions to introduce a crucible experience as the trainees' assumptions are challenged. As designers pay closer attention to the perspective that trainees may be playing from—richer roles can be created to enhance gameplay.

Narrative and Storytelling

In the narrative phase of the Simulation Experience Design Framework (Figure 2), a designer considers the types of narratives among trainees are likely to ensue in the adaptive training system. Narrative plays a powerful role in virtually all forms of human activity. For example, artificial intelligence has long recognized the power of scripts and other narrative structures in creating and organizing knowledge (Schank & Abelson, 1977; Schank & Morson, 1995). Although a shared graphical environment is not always necessary for groups to establish rapport and trust (Raybourn, 1998; Leevers, 2001), supporting narrative, on the other hand, has been deemed essential (Murray, 1997). Narratives are supported by the scenarios written by designers. Scenarios can be constructed to include the subtext of interdependent, yet conflicting roles, or hidden information that only certain roles possess. The crucible experience for a particular trainee may be in realizing that if she had made the effort to extract actionable intelligence from another role-player in the virtual environment she would have solved her problem or at least had a more robust solution. For example, a scenario may suggest that a battalion commander has been invited for tea with a host nation elder of a village. If the trainee playing the role of the battalion commander perceives the communication event as trivial she may decide to send a representative which may adversely impact her subsequent interactions with the villagers. Scenario design can guide trainees to either fall into the trap of assumption and stereotype, or avoid the pitfalls and exercise adaptive, critical thinking and cultural awareness skills.

Place

In the third phase of the Simulation Experience Design Framework (Figure 2), a designer considers how the dance among interactions and narratives coupled with the visual environment create a place that engenders discovery. Prior experience has demonstrated that trainees appreciate interacting in electronic places that are capable of 'responding' to their actions, therefore providing useful feedback about the state of the virtual world. In a multiplayer game, the trainee interacts with both other interlocutors and the environment. Therefore integral to the design of 'place' is allowing trainees to contribute to the environment, and develop an ownership for the artifacts in the place as well as the narratives that it supports. Players must be allowed to leave their cultural footprints in the game-based training system so that they can *feel that the virtual environment is alive.* Allowing each person to actively contribute to the development or design of a place through narrative and co-creating outcome will enhance the gameplay experience. In other words, designers should let players express their characters' identities through interaction with visual or textual artifacts in the game level. Interacting with game artifacts in a culturally relevant setting arouses curiosity, sparks cross-cultural discovery, and engenders cross-cultural communication. For example, allowing trainees to perform actions they would normally in real life such as drive vehicles, hold, keep, and exchange objects, or see the consequences of a decision are critical to creating believable virtual places that support narrative structures. Another example is the design of quiet spaces and private communication channels where teams can be out of the view of others to strategize or consider the actions they will take in the game. This activity has proven to be quite effective in supporting trainees' strategic communication and planning.

Emergent Culture

Designers can create more motivating serious games and training environments by designing for crucible experiences and learner discovery. A designer's careful consideration to the overall environment in general, can engender certain intended or unintended trainee behaviors and communication (Raybourn, 2001). One way to guide learner discovery is to design subtle motivating cues to guide the trainee on how she can contribute to the culture emerging in the training session either through direct participation or silent real-time assessment and reflective analysis of the actions taken or decisions made during gameplay. Later during the after action review, her voice can be heard, as she offers alternatives not taken by the role-players that are equally valid and serve to expand the set of solutions. By contributing her analyses to the after action review, she participates in the co-creation of the group's 'third' culture. "Third culture" is the culture that emerges from multiplayer gameplay that belongs not to one trainee, but to all persons who have participated in the ensuing events, narratives, actions taken, real-time assessments & feedback, and results.

Real-time In-Game Assessment

For example, in developing adaptive training systems, the author instantiated a role in software for observer controllers or peer evaluators to participate in the culture of learning that emerges from real-time, in-game feedback assessments and after action review debriefings. To date, no other training system incorporates a real-time assessment & feedback role even though this activity is critical to developing metacognitive strategies and self-monitoring skills that are necessary to develop adaptive, self-aware leaders. Sandia National Lab's method consists of providing an interface for observers (observer controllers, peer trainees, subject matter or cultural experts, instructors, etc.) to provide in-game assessments of objects and actions taken, (including communications) as they occur in real-time. The assessment process relates to intended training principles and learning points. Trainees or observer controllers quantitatively provide assessments that correspond to logged, time-stamped events. These assessments that correspond to actual events are later aggregated and statistical analyses performed on the individual and group assessments. The assessments are displayed either in realtime (i.e. team assessments) or during the after action review (individual assessments). As trainees and observer controllers take on this role, they reinforce the skills needed to be adaptive critical thinkers as well as provide an assessment perspective never before made available in game-based training systems. Real-time, in-game assessment allows for emergent culture to occur in the game in the form of analyses and evaluations on the actions taken (Raybourn, et. al., 2005), and out of the game during the after action review session in which trainees, observer controllers, and instructors review the course of the gameplay, lessons learned, and outcomes in a large group setting.

CONCLUSION

The last step in the Simulation Experience Design Method is to conceptualize the entire training system in the framework. If an entire training system, from the design of interactions and scenarios played out in a virtual place and in-game assessments of observer controllers to facilitating community-based learning during after action reviews is to support crucible experiences then a seamless integration of each activity should be crafted and crucible experiences peppered throughout the gameplay, assessment, and after action review. A community-based after action review

process in which each individual voice counts, will engender a culture of thoughtful participation, increased risk taking (due to the creation of a safe learning environment), and sharing of novel solutions that expand each trainee's potential solution set. It is our goal that trainees take the lessons they have learned and skills they have developed in our training systems down range to improve their operations. As designers, if we can achieve this, we will have truly contributed to preparing soldiers for real world crucible experiences.

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