Designing Serious Games: Creating Engaging Learning Experiences That Accelerate Performance Outcomes

Kerrin Ann Barrett, PhD
Director, Content Design and Development
Alelo TLT, Inc.

W. Lewis Johnson, PhD
President and Chief Scientist
Alelo TLT, Inc.

Introduction

The paper will describe how Alelo designs and develops serious games that teach foreign languages and intercultural communication skills. Immersive, interactive 3D video games simulate real-life communication, allowing users to role play with animated “socially intelligent virtual humans” that recognize the user’s speech, intent, gestures and behavior. These game experiences are combined with interactive multimedia learning materials to provide learners with immersive learning environments that enable them to rapidly progress from no knowledge of the language and culture to significant levels of job-related communicative proficiency.

Designing Engaging Serious Games: Alelo’s Learning Environment

The pedagogy used in designing Alelo’s courses is based upon constructivism learning theory and is aimed at producing results-oriented, task-based courses. These are designed to provide learners with the specific communication skills that they need for their job, foreign travel, and other interactions. Heavy emphasis is placed on spoken communication. Language learners in foreign countries often have difficulty gaining spoken proficiency, and our approach is specifically designed to address this problem. Learners quickly gain confidence in their ability to communicate face-to-face with speakers of the foreign language. Learning is situated within context in courses that are results-oriented and task-based. Lave and Wenger (1991) argue that learning is embedded within activity, context and culture. This notion of “situated cognition” underscores course design, thus presenting knowledge in authentic contexts — settings and situations that would normally involve that knowledge. Adult learners in particular find this performance-based approach motivating (Johnson, 2007).

Situated instructional design, as described by Wilson (1995) is used to design and develop the courses. Rather than a prescriptive, rigid approach to instructional design, situated instructional design is adaptive and community-oriented, involving multiple stakeholders and multidisciplinary design teams. Customers are closely involved in the process, providing iterative feedback to the course development team, which consists of applied linguists and anthropologists, animators, artists, sound engineers, speech recognition experts, and programmers. This approach has resulted in engaging and effective language-in-culture instruction for such challenging languages as Dari, Iraqi Arabic, and Chinese.

The immersive games provide extensive levels of engagement, motivation and practice through “free form” storylines with very wide ranges of game-play paths, interactive dialogs and action options. Not all virtual humans are the same; each behaves according to its individual personality, cultural background, emotions and intent, consistent with the storyline and in response to learner actions. The storyline’s drama, exploration and elements of surprise include many different opportunities to learn.
The learning environments combine immersive games and interactive instructional materials, and use advanced speech recognition and conversational artificial intelligence (AI) capabilities, to give learners opportunities to develop and practice their communication skills. Figures 1 and 2 illustrate how this is done, taken from the Encounters Chinese language course, being developed in collaboration with Yale University and Chinese International Publishing Group. Figure 1 shows an exercise from one of the interactive Web-based lessons (known as “skill builders”) in the Encounters course. Here learners are prompted to introduce themselves to the woman in the top left in Chinese. Wearing a headset microphone, they must speak in Chinese to perform the exercise. The automated speech processing system evaluates what the learner says, so that the virtual coach (shown at bottom) can provide specific constructive feedback. In this case the coach critiques the learner’s word choice, using “xing” (family name) instead of “jiăo” (name). Through such exercises learners acquire basic conversational skills. They then apply these communication skills in the immersive 3D game, as shown in Figure 2. Here the learner is able to walk up to non-player characters and engage in extended conversations with them.

Figure 1. - Example Mini-Dialog Exercise

Figure 2. - Example Episode Encounters Chinese “Find Your Friend in a Hutong” Game

Theoretical Foundation of Serious Games

Games and simulations may be two of the most powerful tools available to those who design online instruction because they engage and challenge learners in a very personal way (Rude-Parkins, Miller, Ferguson & Bauer, 2005). Designing serious games must leverage the richness of 3D environments to provide situated activities that reinforce the learning and performance objectives of the course. Simulation
and gaming theory is based upon learning theories where behavioral, attitudinal, and cognitive changes due to experience are foremost (García-Carbonell, Rising, Montero, & Watts, 2001). Serious games allow the learner to interact and engage collaboratively in a constantly changing graphical, three-dimensional virtual environment either with other digital artifacts, avatars, or humans (Dede & Ketelhut, 2005).

The notion of situated cognition is fundamental to the creation of 3D worlds that are effective learning environments for language and culture. Lave (1988) put forward the idea that learning is situated within activity and occurs through legitimate peripheral participation. Activity and situations are integral to cognition and learning (Brown, Collins, & Duguid, 1989). Serious games show promise in helping learners acquire basic communicative skills in foreign languages and cultures (Johnson, et. al., 2004).

Constructivism and socio-cultural theory also underscore the creation of effective and engaging serious games. Constructivism acknowledges that learners themselves are active agents who engage in their own knowledge construction by integrating new information into their existing schema and by associating and representing it in a possibly unique ways that are meaningful to them (Miller & Fallad, 2005). Sociocultural theories of learning posit that individuals learn by socially interacting and conversing with others (Lantolf & Thorne, 2006). Therefore, game-based environments for educational purposes that employ pedagogical agents, in particular those that teach language, are fertile ground for learning socially appropriate ways of interacting across languages and cultures.

A supporting theory underlying Alelo’s immersive games is Spiro’s cognitive flexibility theory (CFT), which focuses on the nature of learning in complex and ill-structured domains (Spiro & Jehng, 1990). CFT is premised on the notion that most knowledge domains are complex and ill-structured, as are the situations faced by many learners in today’s world. Knowledge restructuring is a critical component of a learners’ training vector as they engage with the content.

**Instructional Design Models: Creating Engaging Learning Using Serious Games**

The instructional design approach used to create Alelo’s skill builders and immersive games is based fundamentally on the ADDIE model, a process heuristic shared by many instructional design models. More specifically, aspects of Wilson’s (1995) situated instructional design model and Tripp & Bichelmeyer’s (1990) rapid prototyping model are used to design and develop the overall content for the game-based courses. The process of designing the skillbuilders and immersive games is iterative in nature, and highly dependent upon communication between subject matter experts, and the production and technical staff in order to realize a course of instruction that is at once effective and engaging.

One design methodology that has been used successfully in software engineering is rapid prototyping (Tripp & Bichelmeyer, 1990). Tripp and Bichelmeyer argue that rapid prototyping also applies to instructional design for computer-based instruction. They state that rapid prototyping method allows greater flexibility when dealing with the complexity of a human-factors intensive field such as the process of instruction. Central to designing and developing a serious game is the reality that various processes do not occur in a linear fashion. In the rapid prototyping model, the complexity and uncertainty of situations is acknowledged, rather than minimized as in traditional ISD.

Situated instructional design, as described by Wilson (1995) is used to design and develop Alelo’s language –in-culture training programs. Rather than a prescriptive, rigid approach to instructional design, situated instructional design is adaptive and community-oriented, involving multiple stakeholders and multidisciplinary design teams. Each training program is a combination of instructional activities and immersive games, where learners apply their newfound communication skills to complete a task in a simulated environment.

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Subject Matter Experts and the Design and Development Process

Subject matter experts (SMEs) are an integral part of the course design and development effort. SMEs include customers as well. Working effectively with a SME to develop a serious game is important because the analysis step is often missed or glossed over in the instructional design process. Early in the course design phase SMEs should be interviewed, where applicable, using a modified job/task analysis approach. Morrison (2000) states that cooperative design should be encouraged amongst stakeholders through all stages. Despite the SMEs importance in the instructional design process, one of the challenges often faced by instructional designers is the lack of SME availability to answer substantive questions. Indeed, decision making without adequate information is typical of design (Tripp & Bichelmeier, 1990). Optimally, SMEs from target cultures and the customer would have a hand in every step of content development, including initially assisting in identifying tasks that would be interesting and relevant to learners. Once the tasks have been outlined, SMEs would continue to be involved in the curriculum development process by identifying cultural and language interest points, and helping to author exercises by suggesting common errors and possible false responses. Once adequate information is gathered, content development proceeds in an iterative process as current content is validated and additional information becomes available from SMEs.

Designing for Accelerated Performance Outcomes

Computer simulation gaming offers the opportunity for instructional designers to design learning environments that are at once engaging and content-rich, resulting in accelerated performance outcomes. The task-based approach has been found to be a very effective method of presenting language and culture to learners (Johnson, Wang, & Wu, 2007). Tasks are an important feature of communicative language teaching, which aims to develop in learners the ability to use language in real communication (Ellis, 2003). Through placing learners at the locus of control (first-person), they are able to become full participants in the simulation, experiencing the results of their decision-making (affect) in a safe environment. Results from evaluations of the Tactical Language products indicate that learners were able to transfer their cultural knowledge and linguistic skills to the field. Anecdotal evidence showed that participants knew what to say, and when to say it. Computer gaming, with its rich immersive environment and virtual avatars, shows promise for accelerating performance outcomes through learner practice in simulated environments that seamlessly transfers to the real world.

Conclusion

Serious game design is challenging by nature. Authentic contexts are difficult to create, and many different variables are possible from a given number of scenarios depending upon the rules and contingencies designed into the game. Instructional designers must be constantly aware of the game’s objectives as they design the game-play in order that the knowledge and skills gained within the game are able to be transferred to actual contexts. Immersive games offer learners an opportunity to practice their skills and knowledge in a safe environment, receiving constructive feedback from a pedagogical agent. Initial results on the impact of serious games in achieving language and cultural competency are positive. With rapid advancements in technology and in the field of AI, serious games are poised to play an important role in training and education, especially in the area of social simulations.

References


**Author Summary**

**Dr. Johnson** is a noted expert in the fields of artificial intelligence and serious games. He was a research professor at the University of Southern California for 22 years. Dr. Johnson co-founded Alelo while he was director of the Center for Advanced Research in Technology for Education (CARTE) at the Information Sciences Institute of the University of Southern California, where he was the principal investigator of the original Tactical Language project that resulted in Alelo’s software products. Dr. Johnson holds a B.A. in linguistics from Princeton University and a Ph.D. in computer science from Yale University.

Address: 11965 Venice Blvd.
Los Angeles, CA 90034
E-mail: [www.alelo.com](http://www.alelo.com)
Phone: 310-566-7060
Fax: 310-566-7069

**Dr. Barrett** has over 20 years experience in designing, developing, and implementing courses for a wide variety of audiences in the public, private, and international sectors. In 2008, she obtained her Ph.D. from the University of New Mexico in Organizational Learning and Instructional Technology, with a research focus at the intersection of distance education, culture and language learning. She holds an Ed.M. in
Technology in Education from the Harvard Graduate School of Education. She is currently the Director of Content Design and Development for Alelo TLT, LLC.

Address: 11965 Venice Blvd.
        Los Angeles, CA 90034
E-mail:  www.alelo.com
Phone:   310-566-7060
Fax:     310-566-7069