Role-Playing Simulation as an Educational Tool for Health Care Personnel: Developing an Embedded Assessment Framework

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Abstract

Simulation- and video game–based role-playing techniques have been proven effective in changing behavior and enhancing positive decision making in a variety of professional settings, including education, the military, and health care. Although the need for developing assessment frameworks for learning outcomes has been clearly defined, there is a significant gap between the variety of existing multimedia-based instruction and technology-mediated learning systems and the number of reliable assessment algorithms. This study, based on a mixed methodology research design, aims to develop an embedded assessment algorithm, a Knowledge Assessment Module (NOTE), to capture both user interaction with the educational tool and knowledge gained from the training. The study is regarded as the first step in developing an assessment framework for a multimedia educational tool for health care professionals, Anatomy of Care (AOC), that utilizes Virtual Experience Immersive Learning Simulation (VEILS®) technology. Ninety health care personnel of various backgrounds took part in online AOC training, choosing from five possible scenarios presenting difficult situations of everyday care. The results suggest that although the simulation-based training tool demonstrated partial effectiveness in improving learners’ decision-making capacity, a differential learner-oriented approach might be more effective and capable of synchronizing educational efforts with identifiable relevant individual factors such as sociobehavioral profile and professional background.

Introduction

The social, technological, and financial challenges faced by the modern health care industry require a dramatic change in its educational tools that are still inherently unresponsive to the increased demand for targeted education and training. New approaches to health care education must fully incorporate advances in technology and understanding of human motivation and behavior, thus providing education that is aligned with the 21st century: fast, user friendly, and easily accessible. Health care education accomplishes these goals with technology-mediated solutions: online education, medical simulation, human computer interface, and 3D multimedia.1–4 At the same time, the primary focus of educational innovations remains on improving professional skills, including communication, associated with the better quality customer service.

Effectively managing employees’ communication skills is essential for today’s health care organizations. In a hospital, one bad encounter can leave a patient with a negative impression of his or her entire experience. Leaders in the health care industry are constantly searching for innovative methods to instill in health care providers the attitudes and behaviors necessary for a customer-oriented environment. Existing customer service training products specific to health care organizations are, however, expensive, time consuming, and inadequate.5

Simulation- and video game–based educational technology has been proven effective in changing behavior and enhancing positive decision making in a variety of fields, including health care,6,7 management, the military,8,9 and education10 itself. Immersive learning simulations have been shown to improve individuals’ decision making under real-life stress.4 Research on interactive simulation as a learning

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tool for adult learners shows that limited data exist on outcomes of visual simulation gaming in health care. Therefore, current trends in education reflect a paradigmatic shift in learning theory aimed at understanding the interaction between the learning environment and individual parameters such as prior knowledge, life experiences, and level of accumulated skills.

Although the need for developing assessment frameworks has been clearly defined by various authors in the industry,12,13 a large asymmetry occurs between the variety of existing simulation- and video game–based learning systems and the availability of reliable assessment instruments. The purpose of the presented pilot study was to develop an embedded assessment framework for an online educational tool for health caregivers based on Virtual Experience Immersive Learning Simulation (VEILS) technology. Specifically, this study is a first step toward developing a self-organizing gaming simulation-based learning environment with an individually tailored assessment algorithm incorporating item response methodology.

Educational Simulation-based Role-Playing Intervention: Anatomy of Care

The Simulation and Training Environment Laboratory (SiTEL), affiliated with the Washington Hospital Center, in partnership with Potomac, Maryland–based WILL Interactive, Inc., created VEILS to address the critical area of customer care for hospital staff: Anatomy of Care (AOC). AOC is an online educational customer service training module designed to educate all hospital staff, from doctors and nurses to clerical staff to patient transporters and environmental services employees. This module teaches health care workers how their actions affect patient care, the overall image of a hospital, and the world of health care by allowing them to watch themselves in action. AOC is a Web-based training program (see Fig. 1) designed to improve the way health care workers respond to difficult situations that confront them every day.

Players role play a character (doctor, nurse, unit clerk, patient transporter, or environmental service worker) at a fictional metropolitan hospital. In the VEILS, learners are presented with stressful “slice-of-life” scenarios in which they must make tough decisions and live out the consequences of their actions. Successful navigation of the interactive movie requires honest compassion, sensitive interpersonal dealings, and clarity of values. The goal of the developed simulation training is for health care workers to understand their behaviors from the perspective of the patient, families, and other hospital employees. The AOC allows users to play out difficult situations in the safety of cyberspace before they live them out.

The experiential learning provided by the AOC simulations builds on expressed organizational values and shows users the consequences of their chosen responses to presented situations. The AOC demonstrates the reality that in a hospital, every encounter with a patient is important. Each encounter can influence patients and their families about the hospital experience and the medical care they receive. The quality of care and each customer’s perception of that care have very real consequences for the success of the institution. In AOC, the player role-plays one of the following five hospital team members working at Metro Hospital: Clara, a desk clerk with a mastery of her position’s busy pace; Janice, a charge nurse increasingly becoming a leader in the hospital; Kyong, an environmental services technician who does not feel he is a part of the greater team; Emilio, a transporter with an engaging, charismatic personality; and Dr. Aaron Klinger, a senior resident with a very busy life (see Fig. 2).

Study Design and Methods

Research design

The study used a mixed methodology approach including (a) a repeated measures research design with pretest and posttest of knowledge in health care personnel involved with the simulation-based training; and (b) an in-depth analysis of the assessment framework based on exploring role-playing preferences in the context of age (sociobehavioral factor), professional background and education (professional background factor), and job experiences, including years worked at the organization and job placement (organizational factor).

FIG. 1. Anatomy of Care online.
Participants

Ninety health care personnel of various backgrounds and professional experience took part in the AOC training with embedded assessment.

Settings

The study took place at two large medical facilities collocated on a single campus: Washington Hospital Center and National Rehabilitation Hospital in Washington, DC.

Procedure

A set of seven laptops with online access were used for the training project. Each participant worked independently, using headphones to minimize distraction. An instructor experienced in both computerized interventions and the AOC provided a brief introduction to the online training and was available should the need for additional information arise. On average, each session lasted up to 40 minutes. It is important to note that facility leadership supported this training, and employees were permitted to participate during work time, as feasible.

The Knowledge Assessment Module (NOTE)

During a preliminary feasibility pilot study, the AOC was introduced to 1,500 employees in facilitated group sessions at various health care facilities at Washington Hospital Center, part of MedStar Health, over a 3-month period. During this time, the need for tools tailored to the evaluation of virtual role-playing training clearly emerged. The Knowledge Assessment Module (called NOTE for short), developed for role-playing interventions and piloted with the AOC, is focused on (a) exploring the interaction between gaming parameters and individual profiles, and (b) analyzing the interrelations between knowledge gain based on comparison of preassessment and postassessment and various individual factors. The embedded assessment framework incorporates two major elements: five 3-minute video clips representing one of the stressful situations and a multiple-choice scale, representing different—effective and ineffective—decision-making strategies (see Table 1). The content of the video clips and multiple-choice scale reflected an organization-tailored system of values that is part of the corporate culture. The MedStar Health system of values incorporates five basic dimensions of quality care: SPIRIT, an acronym for Service, Patient first, Integrity, Respect, Innovation, and Initiative.

NOTE was administered twice during an individual session: once before and once after the simulated training. It consisted of five situations, each involving one of the five role-play characters in the AOC (see Table 2). Providing responses to NOTE consumed up to 10 minutes of users’ time. Each situation in NOTE depicted a difficult everyday care situation that was used in the training video. NOTE then presented the user with three possible coping scenarios. The user was asked to select 1, the best possible response, and 2, the worst possible response, to the presented challenge (see Table 1). The same set of situations was presented in both pretesting and posttesting modes. The NOTE algorithm assumed coding of the participants’ responses into an ordinal (continuous) scale, assigning values to responses on the basis of their ranking with respect to one another: 1, possible worst response, 2, possible next to best response, 3, possible best response. The ranking was developed by two independent trainers and showed an interrater reliability of 0.91. For each participant, a cumulative score was calculated in NOTE representing the

FIG. 2. Anatomy of Care role playing.
**Table 1. Scenario-based Role Coding (A Fragment of the Knowledge Assessment Module)**

<table>
<thead>
<tr>
<th>Scenario parameters</th>
<th>Descriptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character (role)</td>
<td>Clara</td>
</tr>
<tr>
<td>Setting</td>
<td>Nursing station</td>
</tr>
<tr>
<td>Personages involved</td>
<td>Unit clerk and patient (on phone)</td>
</tr>
<tr>
<td>Situation description</td>
<td>The call bell rings.</td>
</tr>
<tr>
<td><strong>MedStar SPIRIT value</strong></td>
<td>$I^2$ (Innovation and Initiative)</td>
</tr>
<tr>
<td>Alternative responses:</td>
<td></td>
</tr>
<tr>
<td>best possible response</td>
<td>A. Swallow your pride and offer to get him some dry cereal**</td>
</tr>
<tr>
<td>Alternative responses:</td>
<td></td>
</tr>
<tr>
<td>worst possible response</td>
<td>A. Swallow your pride and offer to get him some dry cereal</td>
</tr>
<tr>
<td>Video clip and response code</td>
<td>Clara</td>
</tr>
<tr>
<td>Code: 3**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Code: 2</td>
</tr>
<tr>
<td></td>
<td>Code: 1*</td>
</tr>
</tbody>
</table>

*The correct worst possible response.
**The correct best possible response.

mean of either worst or best responses across the five situations. In addition to NOTE, each participant was administered a brief Computer Experiences Scale.

**Analysis**

The first-phase analyses included descriptive univariate and bivariate statistics such as frequency distributions, means, standard deviations, and correlations, regarding interplay between learners’ demographics, including age and gender, their level of professional experience, and their level of computer skills. During the second phase, correlations and a nonparametric paired $t$ test (preassessment vs. postassessment) regarding the multimedia education experiences and demographic variables were explored in order to investigate how responses to educational role playing depend on socio-behavioral (age and gender), professional (education and years of work experience), and organizational (job placement and years worked at the current organization) factors. Separate $t$ tests were performed for the groups differentiated by the individual factors. During the third phase, a repeated measures generalized linear model (GLM) was used to obtain maximum likelihood estimates based on a link function that characterizes the relationship of the mean response to a vector of covariates. GLM was implemented to analyze the main effect of the educational intervention on individual problem-solving strategy using the preferred type of character-based learning module as an independent variable and the NOTE score change (pretest and postintervention assessment) and covariates such as years of experience, age, and education as the dependent variables.

To analyze the learning outcomes based on NOTE, participants’ responses were recoded. The preevaluation and postevaluation scores were compared using both item-by-item and mean score methods on gender, age, professional experiences, position, and role preference using parametric and nonparametric $t$ tests and repeated measures GLM.

**Results**

**Learner’s profile**

The age range of the 90 health caregivers was 21 to 72 years ($M = 42$). The majority of the participants were female (79%). The racial composition of the group was as follows: American Indian (2%), Asian (6%), Caucasian (32%), Hispanic (6%), African American (38%), with 17% of responders who preferred not to identify their ethnicity. The responders’ educational level varied from high school diploma (10%) to scientific degree such as medical doctor (4%), with highest prevalence being a baccalaureate (38%) degree. The sample professional structure was characterized by 19% administrative professionals, 4% physicians, 28% nurses, and 49% of other staff such as nursing aids, transporters, and clerks. The group was characterized by a mean of 14 years performance in the current job with a range from 6 months to 42 years. The analysis of the level of computer skills and computer experiences showed that the average participant spent 19 hours per week utilizing the computer at home or at work, with 40% being very comfortable with Web-based and live video-based educational courses. Nonparametric correlation analysis based on both Spearman and Kendall coefficients showed no significant associations between computer experience and age, gender, years of professional/work experience, and education. At the same time, univariate analysis of variance based on the GLM method revealed a statistically significant difference in computer experience ($p = 0.041$) among three major groups of participants: administrators ($M = 21$ hr of computer time/week), nurses ($M = 13$ hr), and other staff, including nursing technicians, transporters, and clerks ($M = 23$ hr).

**Role preferences**

Overall analysis revealed the following role distribution for the group: Clara (39%), Janice (21%), Aaron (16%), Emilio (14%), and Kyung (10%). It is interesting that the role of Clara...
<table>
<thead>
<tr>
<th>Character</th>
<th>Setting</th>
<th>Personages involved</th>
<th>Situation description</th>
<th>SPIRIT value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clara:</td>
<td>Nursing station</td>
<td>Unit clerk and patient (on phone)</td>
<td>The call bell rings. <strong>CLARA</strong> (to <em>Isabel</em>): That’s the call bell. Means it’s coming from a patient’s room. <em>(Picking up phone)</em> This is Clara. How may I— Oh, hello, Mr. Gibson. Yes, I know this is your third call … <strong>VOICE:</strong> And so it is. Because of a mix-up with dietary, the patient wasn’t given breakfast this morning. You’ve already called the hostess.</td>
<td>I² (Innovation and Initiative)</td>
</tr>
<tr>
<td>Emilio:</td>
<td>Hallway/patient room</td>
<td>Transporter and patient</td>
<td><strong>Emilio shuts the cover on the juice machine.</strong> <strong>VOICE:</strong> Since your mind is on supplies, you’re thinking your next move is to restock paper cups, which are running low. <em>(Emilio moves into the hall)</em> Then you notice the call light is blinking over a patient’s room. Now that you think about it, you’re pretty sure it was on when you came in 10 minutes ago. The patient’s door is ajar, and you don’t hear them crying in pain, so you …</td>
<td>P (Patient First)</td>
</tr>
<tr>
<td>Kyung:</td>
<td>Interior hospital corridor (daytime)</td>
<td>Environmental services (ES) technician, charge nurse, ES supervisor</td>
<td>You head up to the second floor. As soon as you’re out of your own department, you feel a little like the Invisible Man. But that’s all right. You don’t mind keeping a low profile. It suits your style. <strong>VOICE:</strong> You get to your assignment, and the clerk tells you that the unit is getting three new admissions. But as soon as you steer your cart into one of the rooms, a nurse stops you—and not pleasantly. <strong>JANICE:</strong> I need room 7 ready for a new patient. STAT. <strong>VOICE:</strong> You hesitate … <strong>KYUNG:</strong> It’s just that I have three other rooms they also need right away— <strong>JANICE:</strong> They’ll have to wait. I’ve got to get my patient in. <strong>VOICE:</strong> At that moment, Charlie, a supervisor, happens to walk by. <strong>CHARLIE:</strong> Everything under control, Kyung?</td>
<td>T (Teamwork)</td>
</tr>
<tr>
<td>Klinger:</td>
<td>Interior hospital, general medical unit (daytime)</td>
<td>Chief resident, unit clerk</td>
<td><strong>Aaron walks briskly down the hall to the nurse’s station.</strong> <strong>VOICE:</strong> You’ve barely begun your rounds when you run into your first hurdle. One of your patients is missing. <strong>KLINGER:</strong> Did Mrs. Harris go home? <strong>CLARA:</strong> She should be in 7A. <strong>Aaron sighs.</strong> <strong>VOICE:</strong> This kind of thing drives you crazy. You were just in 7A and the room was empty. The clerk should really be able to keep track of the patients on her unit. <strong>KLINGER:</strong> Did Mrs. Harris go home? <strong>CLARA:</strong> She should be in 7A. <strong>Aaron sighs.</strong> <strong>VOICE:</strong> This kind of thing drives you crazy. You were just in 7A and the room was empty. The clerk should really be able to keep track of the patients on her unit.</td>
<td>R (Respect)</td>
</tr>
<tr>
<td>Janice:</td>
<td>Hospital conference room</td>
<td>Charge nurse, vice president of services, group of colleagues</td>
<td>In the meeting room, the vice president asks for additional issues. You say, “I don’t want to sound like a broken record, [et cetera …]. The vice president says, “I’m sorry, it will.” <strong>VOICE:</strong> You’re feeling frustrated and ignored. You’ve brought up facilities before but haven’t seen any action on them. Do you keep pushing?</td>
<td>S (Service)</td>
</tr>
</tbody>
</table>
was similarly attractive for both males and females (47% and 37% respectively). The second-most preferred role was Dr. Aaron Klinger for males (32%) and Janice for females (27%). The least preferred role for males was Kyung (5%). Dr. Aaron Klinger and Kyung tied (at 11%) for least preferred for females. Role preference may be associated with many factors. In our study, significant differences existed between the five groups coded for a specific role preference with regard to total years performing their particular job ($p = 0.049$). Specifically, the highest mean of 19 years characterized the participants preferring the role of Janice, while preference of the Kyung role was associated with the lowest mean of 10 years doing a particular job. No differences among the groups based on role preference were found with regard to race, age or computer experience.

**Learning outcomes: a differential approach**

Overall group evaluation showed no differences on pretest and posttest with regard to recognizing the best or the worst possible response to the presented scenario. However, while using a split group based on gender criteria, a nonparametric Wilcoxon signed ranks test showed that males improved their scores on the cumulative score for identifying worst responses (pretest $M = 1.56; p = 0.049$). Females also showed improvement with regard to identifying the worst possible response in scenario 5, the nurse’s dilemma (pretest $M = 2.7; p = 0.049$). Scenario 5 dealt with a highly equivocal situation requiring balanced adherence to principles of patient advocacy in the face of administrative nonresponsiveness. The learning outcomes analysis based on participants grouped by position criteria (administrator, nurse, and technical personnel) data showed that for nurses, learning outcomes are differentiated depending on the user’s choice of best response for situation 5 ($p = 0.031$), while for technicians, the best response for situation 1, the unit clerk’s dilemma (pretest $M = 2.1; p = 0.065$) is a marginally significant differentiator. The unit clerk’s dilemma deals with going “an extra mile” for patients even though their actions may be unreasonable and antagonistic.

Analysis of knowledge gain using “total years doing this job” criteria revealed that responses to scenario 5 were most sensitive to the provided training. Individuals with 10 to 19 years’ work experience demonstrated significant improvement in recognizing the worst possible response (pretest $M = 2.6; p = 0.031$) while the groups with the lowest (0–9 years) and highest (≥20 years) years of experience showed no significant trends.

**Discussion**

**Learners’ profile**

Understanding of learners and their contexts is the key to designing effective training and meaningful assessments and to promoting the incorporation of new learning into practice. Reigeluth describes the paradigm shift that has occurred in instructional design as society has progressed from the Industrial Age to the Information Age. Whereas once standardization was the watchword, in the 21st century, customization is the new key to successful training efforts.

Of the three types of staff members participating in AOC training, nurses were the most homogeneous in terms of specific occupation and constituted the single largest occupational cohort whose interaction with the AOC was examined. It is perhaps noteworthy that nurses logged just over half the weekly computer time as did either the administrative or technical groups who played the AOC. The fact that staff nurses typically do not have a computer or other workstation dedicated to their exclusive use cannot account for this variance because the same can be said of the occupations (e.g., nursing techs, transporters, and environmental services workers) composing the other groups. The disengagement of nurses from computing technology suggested by our sample signals a need for its consideration in both design of training and structuring of assessments. Nurses have been shown to be equivocal about online and computer learning environments. Among third-year nursing students in a Web-enhanced nursing curriculum program, satisfaction was determined to be a function of both media and content. Student nurses’ satisfaction increased in proportion to their technological readiness (i.e., information technology literacy skills) and their access to the system (i.e., technology ownership). It also increased in proportion to perceived quality and usefulness of content.

The characterization of computer skills in nurses is, of course, complex and highly individual. Nurses, like all other learners interacting with role-playing games in which a participant assumes the role of a fictional character, bring a variety of real-life roles to the online role-play arena. They have characteristics in common with their profession; probably of equal significance are the characteristics they share with their generation. Several recent efforts have tried to map personal contexts and learning styles in nurses across the generations of individuals thought to make up the body of nursing today, most prominent of whom are the Baby Boomers (born in the mid-20th century) and Generation X (born between 1961 and 1981). Varying concepts of authority, dedication, and trust seems to be as important to the acceptability of online training as is familiarity or lack thereof with the technology itself.

**Role preferences**

Analysis of role preferences suggests that assessment algorithms embedded in multimedia educational role-playing games should employ a design that is sensitive to seniority, gender, and the sense of self that characterize its target audiences. The purpose of the AOC is to teach interpersonal skills and attitudes that promote a “patient first” ethic throughout the clinical environment. The scenarios of the AOC provide an instructional design vehicle for the tenets of social learning theory as they focus on learning through modeling the behavior of others. For this technique to be effective, the learner should find common cause and identify with the character whose role he or she will play in the AOC game. The selected character’s behaviors, both positive and negative, should have relevance to the learner so he or she will be moved to internalize them.

Analysis of characters chosen across the various categories of AOC participants revealed a preference for same-sex characters and characters of higher status. Choosing a lower status character, however, correlated with players of
very brief work experience. Role-playing allows an individual to “try on” a new identity as well as to participate in experiences from another’s perspective. This freedom to experiment with role-playing activity, however, makes it difficult to draw conclusions about its learning impact while limiting analysis to observation of play trajectories or pretesting and posttesting scores. A conceptual assessment model of learning outcomes should consider whether learners actually agreed with those behaviors or would, in fact, carry them out in the care setting. Follow-up information is needed to strengthen the predictive power of suggested learning algorithms.27

Learning outcomes

Participants were more precise in identifying the worst response based on percentage overall and on characters. The theme that dominated the worst response variance was communication: when to hold fast to one’s perspective and when to yield. The institution valued holding fast in communications with coworkers and yielding in interactions with patients. More proactive behavior was better understood by more experienced staff. Less experienced staff rapidly understood that they were to put the needs and perhaps unreasonable demands of others first. The most senior staff, however, had difficulty with the value of assertive behavior in interactions with one’s superiors. This outcome tracks the intergenerational differences noted as being in need of harmonizing in nursing.21 Data from the current study suggest that generational characteristics are more salient in teaching interpersonal skills and attitudes than are purely occupational ones.

Conclusions and Future Steps

The assessment paradigms in multimedia-based education for health care staff need to advance a new methodology based on a more individualized approach while employing behavior modification gaming and simulation as learning tools. A conceptual framework for learning outcomes should consider that knowledge gain evaluation is a nonlinear process and exists along multiple dimensions. These include individual (gender, age), contextual (work experience), and environmental (position) factors. A standard preassessment/postassessment does not provide rich enough detail to determine why participants navigated and responded to assessment and in-game scenarios as they did. Nor does it provide insight into what the implications of those responses are for predicting how health care personnel may translate knowledge demonstrated in the environment of the gaming training intervention into the environment of the health care organization and practice. Reflective journaling conducted in parallel with navigating the scenarios of the AOC might be a next step in developing a rich and informative assessment framework for role-playing games in training and education.

In the presented study, we explored several major contextual factors that need to be considered in further development of the NOTE algorithm: a learner’s profile and role preferences. In the next phase of study, an embedded assessment algorithm will be implemented in stepwise fashion, providing the possibility of individual tailoring of performance evaluation. This algorithm, using item response theory methodology, can provide an opportunity to account for covariates such as gender, years of experiences, and status, as well as a baseline evaluation of prior knowledge, thus making a posteducational assessment more relevant to the training objectives. As computing technology increasingly penetrates health care environments, correlation of performance on the AOC with patient satisfaction trends by unit will be possible. This linkage will both help identify groups and individuals in need of training and provide validation of the basic assumptions of the AOC: that the values it promotes authentically support patient satisfaction.

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