Nurse Education Today 46 (2016) 81–85

Contents lists available at ScienceDirect

Nurse Education Today

journal homepage: www.elsevier.com/nedt

Virtual gaming to develop students' pediatric nursing skills: A usability test

Margaret Verkuyl NP-PHC, MN, AGD:ANP [a], Lynda Atack R.N., PhD [a,*], Paula Mastrilli R.N., MScN, PhD [b], Daria Romaniuk RN, PhD [c]

[a] Collaborative Nursing Degree Program, School of Community and Health Studies, Centennial College, P.O. Box 631, Station A, Scarborough, ON M1K5E9, Canada
[b] Collaborative BScN, RPN Bridge, Post Graduate Nursing Programs and Simulation Centre Sally Horsfall Eaton School of Nursing George Brown College, Toronto, ON M5A 1B6, Canada
[c] Daphne Cockwell School of Nursing, Ryerson University, 350 Victoria St., Toronto, ON M5B 2K3, Canada

ARTICLE INFO

Article history:
Received 16 March 2016
Received in revised form 8 August 2016
Accepted 22 August 2016

Keywords:
E-simulation
Online
Nursing education
Pediatrics
Usability test

ABSTRACT

Background: As competition for specialty clinical placements increases, there is an urgent need to create safe, stimulating, alternative learning environments for students.
Objective: To address that clinical gap, our team developed a virtual game-based simulation to help nursing students develop their pediatric nursing skills.
Design: A usability study was conducted using the Technology Acceptance Model as a research framework.
Setting and Participants: The study was conducted at a community college and included nursing students, nursing faculty/clinicians and two gaming experts.
Methods: The two experts evaluated the game using a heuristic checklist after playing the game. Participants engaged in a think-aloud activity while playing the game and completed a survey and interview based on the Technology Acceptance Model to explore ease of use and utility of the game.
Results: We found a high degree of user satisfaction with the game. Students reported that they had learned about pediatric care, they had become immersed in the game and they were keen to keep playing. Several design changes were recommended.
Conclusion: Usability testing is critical in the early stages of simulation development and the study provided useful direction for the development team in the next stage of game development.
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1. Background

In recent years, there has been a marked decline in access for nursing students in Canadian urban centres to acute care clinical placements, particularly in specialty areas such as pediatrics. This challenge is not confined to Canada, nor is it confined to nursing; it is a worldwide concern that affects numerous disciplines (Niederhauser et al., 2012; Poikela et al., 2015). There is an urgent need to create safe, stimulating learning environments for nursing students so they can prepare for professional practice. Within the last few years, two promising methods that could provide high fidelity nursing experiences outside of clinical settings have emerged: simulation in a laboratory and simulation using a virtual serious game.

While simulation laboratories are now used extensively in nursing programs and the benefits have been well documented (Wood & McPhee, 2011; Pittiglio et al. 2012), they can be very resource demanding in terms of faculty time, lab space and equipment (Gates et al., 2012). With increasing access to quality technology, faculty are now considering web-based or virtual serious games for learning as a way to augment or supplement learning done through laboratory simulation (Cant & Cooper, 2014).

Virtual serious games are games accessed by computer where the purpose is education or training rather than entertainment. They offer a simulation of real-world events with gaming features such as identity, where the users feel they are a character in the game and immersion, meaning that the user feels engaged and motivated to succeed both by the events in the game and their score (Annetta, 2010).

Interest in gaming to support learning is growing not only for practical reasons but because games, by their very design, are fun; they pique interest, encourage thinking and demand active involvement, all key components of motivation and learning (Garris et al., 2002). Games, because they make learning exciting and motivating, may increase students' knowledge retention, problem-solving and critical thinking skills (Cooper et al., 2015). They may also help the learner to explore what it feels like to be a professional in action (Berragan, 2011). Much of the literature describes the use of avatar-based simulations; our team was interested in addressing the clinical gap in pediatric education with an online game using actors or standardized patients. We were keen to identify the right mix of design components to develop a game that would be

* Corresponding author at: Collaborative Nursing Degree Program, School of Community and Health Studies, Centennial College, P.O. Box 631, Scarborough, ON M1K5E9, Canada.
E-mail address: latack@centennialcollege.ca (L. Atack).

http://dx.doi.org/10.1016/j.nedt.2016.08.024
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both realistic, fun and engaging and where learning outcomes would be achieved.

2. The Game

To augment the clinical learning experience and help nursing students and new graduates develop their pediatric nursing skills, our team developed a virtual game-based simulation. The development team included nursing faculty, pediatric nurses and instructional designers. The team used a five phase framework to develop the game (Huang, 2005) that included identifying the educational need, conceptualizing the need into learning outcomes, scenario and technology development, usability testing and revision. The main design was simulation and self-testing however, it also included game features such as immersion, by casting the user as a main character, and challenge; participants were scored based on their decision-making.

The team started by mapping out the normal post-operative trajectory for a pediatric patient and then cross-matched the story line to the Canadian Nurses Association Registered Nurses Entry to Practice Competencies. This link to nursing practice standards or norms builds social identity, a key component in learning (Gee, 2008).

The development team recognized that the game should not simply be a fun activity, it had to be integrated into the curriculum and a good fit with our program's constructivist pedagogy. Development was guided by constructivist/experiential learning theory and research on learning and technology which suggests that learning takes place when the learner struggles with a situation and engages in active experimentation (Kolb, 2014; Kolb et al., 2015) and where learning is context-specific and self regulated (Chambers, Thiekotter & Chambers, 2013). The game environment is highly realistic and supports 'situated learning' (Brown et al., 1989) which is critical in preparing nursing students for the complex world of practice (Pagnacia, 2015). The game consists of 17 short video vignettes that portray nurse, client and family interactions in the context of a nine year old child's post-operative appendectomy experience. Standardized patients play the child and his mother. The game begins with the recovery room nurse giving report on the child to another nurse. Once that video exchange is completed students are faced with their first decision-making point. The students watch three or four brief videos, all outlining a possible decision they, as the nurse could make, and then select the video that reflects the best response. It is important to note that the game is not structured to make content explicit but rather to help learners build their identity and skills as pediatric nurses (Gee, 2008). Kolb's theory was applied in the game design: aware that young adults are graphically orientated, visual learners who are used to the multimedia world where they have the option to try something multiple times until they are successful (Yoder & Terhorst, 2012), the game is entirely audio-visual and students can make numerous attempts at resolving the situation.

Once the students made their choice, they received an immediate video or text response regarding their decision with rationale and reference to the appropriate competencies for Registered Nurses. Students who selected an incorrect option were given reflective questions to ponder, supporting Kolb's (1984) reflective observation component of transforming experience. There were 17 decision making video scenarios and students made decisions regarding best practices for a post-operative assessment, respiratory assessment, pain assessment, drug calculation and IV therapy drip rate, communicating with an anxious parent, the use of distraction in pain relief and other nursing skills/situations related to pediatric care.

Because the game was new, a usability test was conducted to give the development team feedback on the ease of use and the usefulness of the game in order to create a user-friendly product that achieved learning outcomes. Usability testing is an essential step in any type of simulation development to identify and remove barriers to the users' experience. Users who resemble the target population evaluate the product against a set of usability criteria (Rubin et al., 2008). The framework underpinning the usability study was the Technology Acceptance Model (TAM). The TAM is a long-standing model originally developed by Davis (1989) and based on Ajzen and Fishbein's (1980) theory of reasoned action which has been used in numerous earlier studies to describe human behavior in health care.

Two principle variables identified in the original TAM model are *perceived usefulness* and *perceived ease of use*. These variables were identified as likely to play a major role in users' acceptance or uptake of a particular technology. While Davis and his colleagues (2006) have since modified the model and identified several other variables that influence uptake, the team decided to focus the usability test the two key original TAM variables. *Perceived ease of use* is defined in this study as the degree to which a person finds a particular technology easy or simple to use and *Perceived usefulness* is defined by Davis (1989) as, "the degree to which a person believes that using a particular system would enhance his or her job performance." With the TAM model as a framework, we followed a two-stage usability testing process developed and used in earlier studies (Nahm et al., 2004; Tullis & Albert, 2008).

3. Ethics

The study was approved by all participating sites' ethics review boards. Participants provided informed consent for the study.

4. Methods

4.1. Stage 1: Heuristic Expert Usability Test

Two expert game developers who were familiar with industry best practices in user game interface design were invited to evaluate the game using a set of rules developed by Nielson (1994) that have become industry standard. They played the game and, using a checklist, identified any possible difficulties that users might have with the interface and recommended design improvements. Among the design features that the experts examined were: the match between system and the real world, user control and freedom, flexibility and efficiency of the game. Changes were made to make the game more user-friendly after receiving input from the experts.

4.2. Stage 2: User Usability Test

Using convenience sampling, nursing students and faculty with pediatric nursing experience were invited to test the game. We recruited a sample of six students and five nurses. Usability studies typically involve five to seven participants. Rubin et al. (2008) note that most problems will be revealed after four participants are tested. An established process, using three methods to collect data was used (Nahm, 2004). The first method was the 'think aloud' approach where participants

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