Teaching clinical reasoning and decision-making skills to nursing students: Design, development, and usability evaluation of a serious game

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ABSTRACT

Background: Serious games (SGs) are a type of simulation technology that may provide nursing students with the opportunity to practice their clinical reasoning and decision-making skills in a safe and authentic environment. Despite the growing number of SGs developed for healthcare professionals, few SGs are video based or address the domain of home health care.
Aims: This paper aims to describe the design, development, and usability evaluation of a video based SG for teaching clinical reasoning and decision-making skills to nursing students who care for patients with chronic obstructive pulmonary disease (COPD) in home healthcare settings.
Methods: A prototype SG was developed. A unified framework of usability called TURF (Task, User, Representation, and Function) and SG theory were employed to ensure a user-centered design. The educational content was based on the clinical decision-making model, Bloom's taxonomy, and a Bachelor of Nursing curriculum. A purposeful sample of six participants evaluated the SG prototype in a usability laboratory. Cognitive walkthrough evaluations, a questionnaire, and individual interviews were used for the usability evaluation. The data were analyzed using qualitative deductive content analysis based on the TURF framework elements and related usability heuristics.
Results: The SG was perceived as being realistic, clinically relevant, and at an adequate level of complexity for the intended users. Usability issues regarding functionality and the user–computer interface design were identified. However, the SG was perceived as being easy to learn, and participants suggested that the SG could serve as a supplement to traditional training in laboratory and clinical settings.
Conclusions: Using video based scenarios with an authentic COPD patient and a home healthcare registered nurse as actors contributed to increased realism. Using different theoretical approaches in the SG design was considered an advantage of the design process. The SG was perceived as being useful, usable, and satisfying. The achievement of the desired functionality and the minimization of user–computer interface issues emphasize the importance of conducting a usability evaluation during the SG development process.

1. Introduction

Education and training that develops healthcare professionals' clinical reasoning skills is emphasized as an important strategy to improve diagnostic performance and reduce overt diagnostic errors. Registered nurses (RNs) play a key role in the diagnostic process while caring for patients. The performance of clinical reasoning among nurses is defined as "the process by which nurses collect cues, process the information, come to an understanding of a patient problem or situation, plan and implement interventions, evaluate outcomes, and reflect on and learn from the process" [1]. RNs with effective clinical reasoning skills may anticipate or identify deteriorating patients and prevent serious adverse events [1,2].

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Recent demographic changes and care reforms [3,4] have resulted in a change in healthcare delivery from hospital to home healthcare services, which has resulted in an increased number of patients with chronic diseases living at home. For instance, the group of patients with chronic obstructive pulmonary disease (COPD) is highly represented in home healthcare services. COPD is expected to become the third leading cause of death worldwide by 2030 [5]. Therefore, it is essential for home healthcare RNs to have a high level of clinical reasoning skills combined with evidence-based knowledge to provide effective and efficient clinical practice and to maintain high-quality nursing care [6,7].

To enable nursing students to respond effectively to the current changes in the healthcare environment, curricula and skills training need to adapt to the evolving healthcare needs in home healthcare services [8–10]. This includes an increased focus on improving nursing students' ability to prevent, recognize, and treat any deteriorating patients to avoid unnecessary hospitalization [3]. Furthermore, nursing education needs to provide simulation training where students are able to apply different types of knowledge in novel, authentic, and practice-based situations [6,8,10].

Recently, simulation technology known as "serious games" (SGs) has appeared in the educational games market [11,12]. SGs are computer-based simulations that combine knowledge and skills development with video game-playing aspects to enable active, experiential, situated, and problem-based learning [13]. SGs represent a learner-centered educational approach in which users control their learning process through interactivity [14,15]. Recently, SGs have been proposed as a type of technology-enhanced simulation that may provide nursing students with an opportunity to practice their clinical reasoning and decision-making skills in a realistic and safe environment [14,16].

The usability issues of some SGs can negatively impact users' experiences and intended learning outcomes [17,18]. Focusing too much on the development of the entertainment-based counterparts of an SG may result in sacrificing learning effectiveness. Learning may also be impaired if the SG has poor usability, which taxes the users' cognitive resources and decreases their motivation to play the game [17]. To ensure a user-centered design, it is important that the SG contents fit the intended users' learning objectives [17,19,20]. Therefore, it is important to conduct a usability evaluation as part of the development process to ensure the usability and learnability of the SG [17,18,21].

Despite the growing number of SGs developed for healthcare professionals [15,22], limited research addresses the development process of SGs in the domain of nursing education [15,23]. Few researchers have specifically addressed the domain of home health care [20,24,25]. Thus, the aim of this paper is to describe the design, development, and usability evaluation of a video based SG for teaching clinical reasoning and decision-making skills to nursing students who are caring for patients with COPD in home healthcare settings.

2. Materials and methods

2.1. Design and development of the SG

The SG prototype used in this study is a single-player online game that was applied to the Bachelor of Nursing program in the domain of home health care. This SG may be categorized under the genre of simulation games because it attempts to realistically mimic a particular clinical work environment [16,22,26].

The development of the SG required a close collaboration with domain experts [22,27]. The development team consisted of a doctoral student and four Bachelor of Multimedia Technology and Design students. The development team collaborated with a RN

practicing home health care, lecturers from the Bachelor of Nursing program, and a physician from a local hospital for quality assurance of the SG content.

In addition to the interdisciplinary collaboration with professionals within the university and from clinical practice, the development of the SG involved different considerations, processes, and technologies, which will be described in the following sections.

2.1.1. Target users

The target users of the SG were second-year Bachelor of Nursing students. Because the content and objectives of the SG needed to fit the users' knowledge and experience [2,17,22], the syllabus was examined to determine their current expected level of competencies in anatomy, physiology, and subjects in medical treatment and nursing. Based on their level of use of computers and e-learning, we concluded that the nursing students' information and communications technology (ICT) skills were average or above average.

2.1.2. Educational content

In our study, the learning objectives of the SG were to increase nursing students' perception and confidence in clinical situations, to promote their systematic assessment of patients as well as choose appropriate actions in specific situations. In accordance with the clinical decision-making model proposed by O'Neill et al. [28], the intention of the SG was to provide nursing students with a learning environment that promoted situated cognition and fostered experiential learning.

The SG prototype provided a video based simulated scenario set in a home healthcare clinical practice. The scenario was based on an RN's visit to a patient who was recently diagnosed with COPD. Information about the patient, cues about his condition, and different quiz-based tasks or questions were provided during the scenario. For example, users needed to provide the patient with information about his diagnosis, treatment, and exacerbation prevention. In addition, the user needed to respond to a situation in which the patient developed a noninfectious exacerbation of his COPD. Tasks and questions were based on evidence-based knowledge and the Bachelor of Nursing curriculum [29,30], and the formulation of questions was guided by Bloom's taxonomy of educational objectives [31]. Bloom's Taxonomy categorizes learning into the domains of cognitive knowledge, psychomotor skills, and attitude. The cognitive domain consists of six major categories: knowledge, comprehension, application, analysis, synthesis, and evaluation [31]. To promote the development of clinical reasoning and decision-making skills, tasks and questions were formulated to encourage students to apply, analyze and synthesize knowledge based on cues in the scenarios.

2.1.3. User–computer interface design

To ensure a user-centered SG prototype design, we employed a unified framework of usability called TURF (Task, Users, Representation, and Function) [32]. In TURF, usability is referred to as "how useful, usable, and satisfying a system is for the intended users to accomplish goals in the work domain by performing certain sequences of tasks" [32]. This framework was developed for the healthcare environment and is often the underpinning framework for ensuring good usability within the design. Furthermore, it is often a method for usability evaluation. The TURF framework was used as a foundation when designing the different components (gameplay and rules, challenges, interaction, and objectives) of the SG described below.

The SG gameplay [22,27] was designed for users to take part in a home healthcare RN's home visit to a patient. For increased fidelity, filmed video clips were used as the graphical basis, using a female RN and a person with COPD as actors. The intention was