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Patient Engagement in the Medical Facility Waiting Room Using Gamified Healthcare Information Delivery

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Abstract. This study explores the proposition that medical facility waiting rooms are an opportune setting to engage with and educate patients while they are waiting for care. In collaboration with emergency department (ED) personnel, we developed *ER Hero,* a tablet-based application for waiting rooms that introduces patients to ED professionals and operations through mini-games and story-like interaction. We evaluated this prototype with human participants to determine how well it performed when compared to paper-based information disclosure presenting the same information. Participants using the application exhibited increased ED knowledge, decreased nervousness, and increased interest. The gamified application outperformed a paper-based approach on some of these aspects. Quantitative and qualitative results of this study have helped identify key design factors necessary for effective engagement with patients in the medical facility waiting room, improved communication between patients and hospital personnel, and enhanced patient experience in the waiting room.

Keywords: Healthcare · Gamification · Human-computer interaction · User experience · Patient satisfaction · Patient self care · Patient relationship management

1 Introduction

Hospital visits are often stressful for both patients and their associates. The first experience and first impression of a hospital visit usually occur in a waiting room. Nearly 50 % of patients associate waiting rooms with boredom, anxiety, or both, even for patients who are visiting for chronic or routine health examinations [1]. Patients' waiting room experiences are a major concern for hospitals and healthcare facilities as patients arrive with certain expectations from the emergency department. These expectations are often influenced by individual specific, pre-encounter, and intra-encounter experiences [2]. Opportunities to engage with patients in a more meaningful and productive manner pre- and intra-encounter have presented themselves in the waiting room, with the average waiting time being 24 min nationally [3]. With the advent of technologies allowing development of gamified healthcare applications, a new opportunity has arisen

which gives healthcare facilities a chance to have a more meaningful interaction with patients before they are seen by medical personnel. *Gamification*, or the use of "game thinking" and "game mechanics" in non-game environments [4–7] can be used as a tool to create more engaging and interactive healthcare applications. In this study, we explore the idea that a gamified informational application in a waiting room could help patients feel less anxious about and more prepared for their upcoming experience. We explore the possibility that a gamified system presenting general relevant medical health information can help decrease nervousness and strengthen future communication between the patient and their healthcare team.

This study progressed by first identifying and understanding the cognitive and affective changes that can be influenced by a gamified healthcare system. Through user research, testing, interviews, and follow up evaluations, key measures were assessed and used for data analysis. Additionally, through the interaction with and study of selected games, the process regarding how these games are designed and developed may be explored and further understood, allowing for identification of usability and user experience development techniques that may be applied to a new program catered specifically to patients in clinic waiting rooms. Ultimately, these findings would allow for the testing and research of gamified materials in hospital waiting rooms, with the purpose of understanding how the provision and dissemination of health information may benefit hospitals and clinics in their attempt to increase patient satisfaction, retention, and treatment experience.

2   Literature Review

Several studies have investigated the waiting room experience and its effects on patients. This body of research provides evidence that the medical waiting room can be a viable opportunity to engage with patients through educational means. Gamification research suggest potential for improved outcomes using a gamified approach.

2.1   Waiting Room Experience and Patient Satisfaction

Poor patient satisfaction ratings can be costly to the facility and its associated health care providers. Healthcare facilities invest heavily in the design of calming atmospheres in order to reduce the antagonistic effect that waiting rooms have on their occupants. To complicate matters, patients' fear and anxiety in the waiting room is often augmented by anticipation of painful procedures and misconceptions that may surround their medical conditions [8].

In medical emergency departments, the most important factors surrounding patient satisfaction include perceived and actual waiting times, frequency of updates regarding process and treatment, staff demeanor and attitude, environment, and perceived standards of technical care [9]. Waiting times can last up to 53 min before being seen by a healthcare provider [3], and can lead to the feeling that the increasing wait time is indeed time wasted and that care has been neglected [10]. Patient satisfaction factors can be improved significantly via greater communication among triage staff and

patients, but often it is difficult to achieve optimal communication when ED waiting rooms are overburdened [11]. Limited human resources mitigate medical personnel's ability to sufficiently interact with patients to reduce the anxiety and agitation stemming from fear and unfamiliarity.

2.2 Patient Education and Engagement

Many healthcare facilities have equipped their waiting rooms with various toys, reading materials, and multimedia systems. Inclusion of these amenities can be an effective means of diverting patients' focus away from the time spent waiting and their immediate illness. Such amenities, however, are usually not informative in nature and do not address the upcoming interaction that is often the source for increased stress and anxiety. We suggest that a medium that informs patients about their visit has greater potential to decrease stress and anxiety. When an "informed, activated" patient interacts with a "prepared, proactive practice team," the management of both acute and chronic diseases is most effective [12].

Research has shown that patients' overall experience and recall of provided electronic health information improved when compared to physical and verbal instruction [13]. One study evaluated the benefits of an educational multimedia program explaining what patients should expect to encounter during their ED visit [14]. Ultimately, the research indicated that patient's satisfaction can be increased when they are introduced to the normal care plan and operations of the emergency room.

Educational multimedia used in the waiting room can provide familiarity for the patients as well as relevant information and knowledge. Patients responded to information provided positively, indicating they not only understood the content provided to them, but would confidently engage in conversations with their care providers during their treatment [15]. These outcomes may help to increase patient satisfaction, benefitting both the facility and its providers.

In studies regarding learning, the relationship between emotion and cognitive activity is quite strong. A user's affective state has a direct impact on both learning and emotional outcomes. For example, concentration and excitement can lead to increased learning and satisfaction, whereas frustration and boredom can lead to decreased motivation and effort [16]. For learning strategies, gamification is one method that has recently become a popular subject of study. Gamification has the potential to be applied to education as it engages and motivates users and actively adjusts their affect as they complete processes revolving around non-game contexts [4–6].

2.3 Application of Gamification in Healthcare Settings

Gamification refers to adding game-like elements to an otherwise utilitarian task [4]. Gamification can enhance user engagement and creation of positive patterns, including increasing user activity, social interaction, and quality and productivity of actions [17]. The incorporation of game-like features can increase motivation because the level of involvement and agency is increased for the task at hand.

While many have observed the benefits of gamification when it is successful, exactly how to leverage gamification to elicit a deep level of engagement is still unclear [18]. Exploring the application of gamification to healthcare information dissemination is an exciting opportunity that can provide valuable insight into how patients may find their waiting room experience different from the typical process. Incorporating information regarding healthcare facility visits can serve as a safe method to link with patients in the waiting room.

Patients in the waiting room are often anxious, bored, or uncomfortable. These feelings result not only from pain and discomfort brought about by their medical condition, but also by a lack of familiarity with the clinical environment. Further, patients may be afraid to ask questions due to overwhelming diagnostic results and terminology, lack of knowledge of the medical procedures they may potentially encounter, and sometimes an uninformed mistrust of their caretakers. The introduction of gamified health materials has presented an opportunity to address these drivers of fear and anxiety and engage with patients in a way that would develop a feeling of motivation, support, and inclusion in their treatment plans.

3   Methodology

To explore the potential of a gamified healthcare information education system in the waiting room, we first evaluated currently available games. Finding each option to be insufficient for this context, we developed an initial prototype in collaboration with medical professionals in a local ED. We evaluated this prototype in a quasi-experiment involving a simulated waiting room experience and online participation.

3.1   Preliminary Research

Health-focused applications on both tablets and mobile phones were assessed for educational content and interactivity. While many were very interactive, most did not provide any means of educational material beyond very basic medical care, such as placing bandages, ointment, and gauze. Other games, while educational, were geared towards practicing medical professionals, with specific diagnoses, interventions, procedures, lab results, and patient information in mind. These were deemed unsuitable for the general audience.

3.2   Prototype Development

Five ER nurses from a local hospital ED were interviewed to inform initial direction and requirements for the application. Follow-up sessions with some of these nurses and other professionals provided additional feedback as the prototyping process progressed. Table 1 outlines the design specifications that were established in the interviews.

Patients in the waiting room are informed primarily through verbal conversation or written pamphlets. Personnel are typically so busy they do not even have time to do more than the required paperwork with patients, leaving little or no time for further

Table 1. Initial design factors from nurse interviews

Design factor	Justification
Medical facility professionals and functions should be the main topics presented	Keeping information focused on the functions and operations of the ER promotes learning about the processes and people, instead of introducing uncertainty about possible diagnoses or conditions
Avoid mention of illnesses/medical conditions or specific diagnoses	Patients who are provided extraneous information about other illnesses may develop unwarranted or uninformed fears/concerns which can lead to anxiety and confusion
Keep textual content at an eighth-grade reading level	Simplified content caters to broad range of patients, reduce the likelihood of unknown, unexplained, or confusing terminology
No timers in the mini-games	Not showing a timer may prevent association with possibly a prolonged wait time
Factors specific to an emergency department	
Education of triage process, levels of acuity, and patient priority	These concepts are critical components of ER patient processing, yet are often poorly understood by patients, leading to frustration and misunderstanding
Education of pain medication approval and administration	Patients often ask for pain medication that is unwarranted. It is important for patients to understand that physicians must approve/oversee certain medication administration, especially narcotics. Patients should understand that techs, nurses, and other staff cannot simply provide pain medications to patients at any time
Help patients articulate their symptoms as well as employ a pain scale	Patients often have difficulty articulating their symptoms and describing their pain level. Providing patients with the descriptors and standards used by medical staff would aid communication
Description of patient arrivals (e.g., ambulance, ICU, personal vehicle)	Patients should be aware that the ER does not simply treat walk-ins or ambulance arrivals. Staff can often be called to other sections of the hospital to provide emergency care

interaction. The only other mentioned educational medium was informational guides provided at the end of a visit, which was said to be "vague with regards to diagnoses" and often overlooked by patients "due to the sheer amount of paperwork after treatment." The educational interventions that do occur in the waiting room are often met with frustration by patients who have performed web searches on their symptoms, resulting in varying or different information, leading to confusion and an early development of conflict.

Based on the interviews, it was determined that the application was to include educational information regarding the processes, professionals, and environment in the Emergency Room. Axure RP Pro was used to create the prototype of the game due to its iterative capabilities. The educational information included in the game was gathered from interviews of ER personnel and general ER practices of the local Emergency Department.

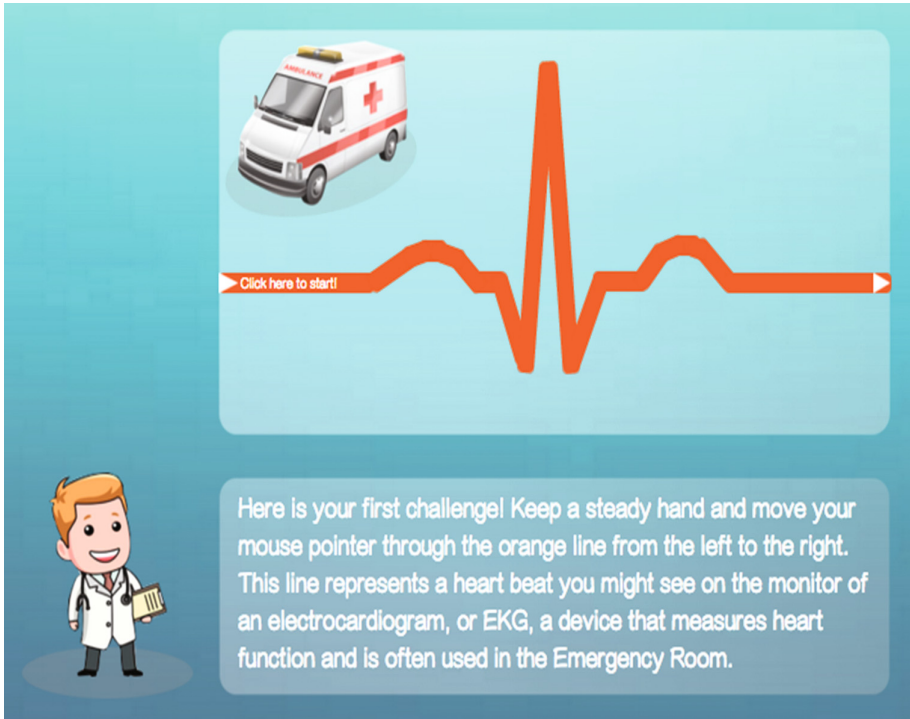Figure 1 shows a sample image of an ER Hero mini-game.

Fig. 1. Sample image and mini-game used in ER Hero

3.3   Experiment

As this research depends heavily on the function of the application, multiple iterations were required for its development. An experiment allows evaluation of the feasibility of the idea, as well as provides insight into important design factors. The experiment was designed to assess gamified prototype performance compared to a baseline that presents standard educational text.

Participants. Students (N = 104) from a midwestern university in the United States were recruited to participate in a quasi-experiment. While patients of all ages can be found in medical facility waiting rooms, focusing on a specific subset of the target population helped to make the project scope more manageable at this early stage.

Experimental Task. Participants were provided a preliminary questionnaire (Q1) when they signed up for participation. To begin participation, participants were prompted to complete a pre-test questionnaire (Q2). Half of participants were assigned to read an educational document, and the other half engaged with the ER Hero application. Both ER Hero and the educational document contained the same educational text. The application group was tested on a desktop computer. Participants were prompted to load the ER Hero game and complete the program. The baseline group was provided the document and also asked to complete the materials. Upon completion, participants were prompted to complete an exit or post-test questionnaire (Q3).

Measures. The levels of users' enjoyment [19], interest [20], and nervousness [21] were measured on a 7 point likert scale. Functional and operational recall of concepts was measured before and after engagement by testing users with 12 multiple choice (4 answer choices each) knowledge questions derived from information reviewed in ER Hero and the text. Participants further reported their understanding of ED professionals and operations via 5 point "familiarity" scales. Questionnaires regarding patient willingness to discuss care [22], and interaction confidence [23] were modified and adapted for this experiment and were measured on a 7 point likert scale.

4 Analysis and Results

To match the sample size (25) in the document condition, all but 25 randomly selected participants were discarded from the game condition. One participant in the document condition did not complete the final questionnaire and was eliminated from the analysis. This reduced total N for analysis to 49 (i.e., 25 participants in the game condition and 24 in the document or control/baseline condition). The means for the phenomena of interest before and after the task for both conditions (i.e., combined) are reported in Table 2. Paired t-tests were used to evaluate significance. Results of the evaluation indicate that educational engagement in the waiting room is correlated with increased ED knowledge, both objective and perceived.

Regression models were used to determine how much of the observed changes were due to gamification. Gender and age were initially included as covariates but were not significant in any model, and were subsequently removed. Results of the exploratory regression models are presented in Table 3. The results suggest that those who used the gamified application reported greater perceived knowledge compared to those who used plain text. Objective analysis, however, revealed no such advantage.

Both types of patient engagement (i.e., gamified application and standard text combined) were correlated with moderate increases in interaction confidence and willingness to discuss healthcare with medical professionals. The gamification in the current prototype did not outperform plain text presentation. In general, patient engagement was correlated with decreased enjoyment, with no apparent effect on nervousness or interest. However, there was no evidence that the drop in enjoyment was correlated with the gaming application, and those who used the gaming application reported significantly less nervousness and more interest.

Table 2. Outcomes of waiting room educational intervention (task)

Phenomena of interest	Pre-task estimate	Post-task estimate	Difference (95 % confidence interval)
Enjoyment	4.52	3.92	**−0.59*** (−0.33− − 0.85)
Nervousness	2.31	2.51	0.16 (−0.12–0.44)
Interest	4.34	4.57	0.24 (−0.09–0.58)
Functional recall	3.5	5.06	**1.56*** (1.15–1.97)
Professional recall	3.76	5.02	**1.22*** (0.80–1.65)
Understanding of ED functions	2.64	3.72	**1.08*** (0.79–1.37)
Understanding of ED professionals	2.38	3.68	**1.30*** (1.04–1.56)
Interaction confidence	4.82	5.33	**0.52*** (0.29–0.74)
Willingness to discuss healthcare	5.30	5.59	**0.30** (0.09–0.51)

Notes: ***$p < .001$; **$p < .01$; significant effects emphasized.

Table 3. Regression results for game (task) condition (vs. document).

Phenomena of interest	Intercept (Std. error)	Pre-task estimate (Std. error)	Game effect (Std. error)
Enjoyment	3.17*** (0.24)	0.16** (0.05)	0.08 (0.10)
Nervousness	2.04*** (0.42)	0.31* (0.15)	**−0.56*** (0.25)
Interest	2.62*** (0.68)	0.36* (0.15)	**0.79*** (0.27)
Functional recall	4.10*** (0.52)	0.25 (0.14)	0.17 (0.33)
Professional recall	3.63*** (0.56)	0.38* (0.15)	−0.09 (0.39)
Understanding of ED functions	2.58*** (0.36)	0.30* (0.12)	**0.69*** (0.21)
Understanding of ED professionals	2.18*** (0.29)	0.48*** (0.11)	**0.70*** (0.19)
Interaction confidence	2.49*** (0.52)	0.58*** (0.10)	0.11 (0.20)
Willingness to discuss healthcare	2.27*** (0.47)	0.62*** (0.08)	0.11 (0.17)

Notes: ***$p < .001$; **$p < .01$; *$p < .05$; significant game effects emphasized.

5   Discussion

As discussed in previous research related to ehealth [24–27], patients who are well informed are more likely to have a more positive experience. To support our gamified program as an effective medium for education, our analysis shows that perceived knowledge was significantly higher in those who used the application. This indicates that users who used the application recognized specific information readily and developed general confidence in their ability to understand their experiences and interactions in the ER. The visual and experiential memory formation that resulted from the use of ER Hero should allow the patients to apply their knowledge when engaging with ER professionals and experiencing medical testing such as having an imaging study performed. We hope to assess whether there is such improvement in future iterations of the application with real patients. We believe that when a user makes the associations between events and processes in the application with their real-time experience, the process becomes encoded and enters the patient's long term memory. These learning components that are built into the game augment the patient's real-life experience, as well as potential future experiences, making the entire healthcare process more relatable, and better understood and appreciated.

It was also shown that in both user groups, interaction confidence and willingness to discuss their health care issues increased. It is possible that the informative and inviting dialogue that developed between the characters within the game helped to lower these perceived communication barriers. We believe that the patient-caretaker relationship is another critical component of the patients' experience interaction. With our preliminary educational intervention, we are able to help users feel more comfortable in their interactions, which in turn makes the entire process more comfortable, and thus may have a positive effect with regard to overall satisfaction. Willingness to discuss healthcare issues is another barrier that is often not easily broken. In these results, however, the use of a gamified medium is effective in helping patients feel more confident. The resulting increased perceived knowledge and newfound confidence supports the gamified program as a viable method for patient development over a simple document.

In general, patient engagement was correlated with decreased enjoyment, with no apparent effect on nervousness or interest. The decreased enjoyment could be due to the text based nature of the application, as gamified components were intermittent amongst multiple dialogues presenting information in a story-like fashion. In our next iterations, we hope to expand the gamified nature of the application so that it is less linear in nature and is also text-heavy. With expansion of the gamified features, the next iteration should use the game aspects to bring the information to the user instead of having the game items embedded within the information. Overall, however, there was no evidence that the drop in enjoyment was correlated with the gaming application, and those who used the gaming application reported significantly less nervousness and significantly more interest.

This opposing valence in interest and nervousness brings us to believe that the gamified application creates an environment for the user to integrate themselves into. When reading a document one may find that they are still very much in the present.

We developed characters (doctors, nurses, techs, etc.) within the game who address the patient, draw them into the experience, and introduce challenges that the user invested themselves in (and in this process learned about the ED). We believe this relationship helps to create meaningful connections with the users who then become more at ease.

6 Limitations and Future Directions

This study was a preliminary test for future iterations and applications. We focused on our prototype that was deployed on desktop computers as opposed to the intended medium of a tablet. In the current study, the test subjects were not real patients and they were not situated in the hospital waiting room. They did not have a wound or ailment as a distraction. Instead, users were prompted to imagine they had an arm injury. Further, some users were tested in the controlled environment of the lab and others were tested on their own personal devices, which could have led to inconsistencies in results.

Future iterations will be designed for and tested on a tablet device. Future testing will also be conducted with real patients in order to avoid any influence of selection bias in the results. While it has been shown that an educational intervention does not improve patient satisfaction, this has not been tested with a gamified application [28], making future testing of this program essential to understanding its worth. In this study, nonetheless, the application has shown promise.

It would be beneficial to test subjects on their perceived waiting time (which is a major factor in patient satisfaction) while engaged with the application versus reading a document. Including timers within the application for mini-game segments is also an area of interest for this research project. Exploration into the measurement of time perception needs to be pursued solely in controlled conditions. Further, the application can be expanded to realms beyond the ER waiting room. Focuses such as vaccination and breastfeeding education are areas we are interested in exploring in future iterations. Once these areas are explored and the program is in real patients' hands, we will be able to understand the effect of this application on overall educational value and its effects on patient outcomes.

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