The Gamification of Electronic Health Records: A Systematic Literature Review

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Abstract

The use of gamification and simulation in medical education is increasing in efforts to accelerate and improve learning outcomes. The purpose of this literature review is to examine game design elements for possible inclusion in an electronic health record (EHR) simulation game (EHRsim). Games are becoming important learning tools in higher education, and numerous organizations use games to teach skills and concepts in medicine, science, and technology. Many in the healthcare professions have questioned the benefits of EHRs and have expressed concern that healthcare professionals who use EHRs without a full understanding of these systems could cause harm to the patient. We explore the literature to determine whether game design elements could be beneficial in creating a learning simulation in which active rather than passive learning about EHRs occurs among teams of practitioners in role-based activities. To find preliminary answers to this question, we conducted a literature review on game design and the benefits that have been realized in other fields from the use of gamification. Our literature review indicates that the addition of game design elements to an EHR system would be beneficial to improve learning and provide training options for health information management professionals.

Keywords: game design elements, electronic health records, gamification, simulation, game genre, game type, educational gaming, EHRsim

Introduction

Gamification is the process of using game design elements in nongame applications or domains to enhance learning, reduce risk, and improve skill acquisition. In other words, one can gamify systems and activities to improve and accelerate the process of learning while also maintaining safety. Some organizations in high-risk environments, including aviation, technology, engineering, mathematics, and medicine, have used gamification and simulations to support learning.[1–4] The use of gamification in medical education is reducing risks for practitioners and patients connected by electronic health record (EHR) systems.[5–8] For example, in settings requiring high reliability, such as emergency departments, intensive care units, or operating rooms, group training via simulation provides an opportunity for immediate task, skill, and procedure debriefing without exposing patients to risk or inconvenience, in contrast to standard classroom training.[9] Unlike a clinical environment, which is rightfully patient centered, a simulation environment may instead be student centered and optimized for learning. Including game elements in the simulation may enhance learning by strengthening students' engagement and increasing practice time for repetitive tasks. While much of the simulation work in medicine and healthcare to date has been related to the simulation of complex human body systems to enable healthcare providers to practice clinical encounters, in this study we explore applying simulation to complex EHR systems to practice encounters with patient information and workflows.

Simulation and gamification can be useful for role-based training outside the typical classroom.[10] For example, Capital BlueCross reduced errors in insurance application enrollment by 66 percent by introducing a video-game training program.[11] Simulation is an accepted methodology for training healthcare professionals and is fast becoming a professional assessment and certification tool.[12]

In typical classroom learning approaches, students must read a text and take part in an instructor-oriented lecture, making the students relatively passive learners. In simulation learning, the student and the student's acquisition of skills and knowledge become the center of the learning process, requiring greater student engagement.[13] Some research suggests that when students use simulation in skill training, they acquire and retain more knowledge and also become more proficient than when learning in a traditional classroom.[14]

Because of risk and reliability issues, efficiency and effectiveness requirements, team-based and role-based learning needs, and active versus passive learning improvements, greater attention is being placed on novel training and education activities for use with EHRs.[15] Health information management (HIM) professionals must critically assess best practices and safe implementation of EHRs. Implementation should include effective initial and ongoing training using active learning in which teams of practitioners perform role-based activities to acquire knowledge and skills related to the use of the EHR system.[16] In this paper, we explore game design to determine which gamification elements might be included in an EHR simulation to improve the quality of learning and support options for the training of HIM professionals.

Method

The methodology of this study to explore the benefits of gamification of EHRs used the basic principles of a systematic review followed by Coustasse et al.[17] and created by Yao et al.[18] The study was conducted in three stages: (1) identifying literature and collecting articles, (2) analyzing and evaluating the discovered literature, and (3) categorizing the literature.

Step 1: Literature Identification and Collection

The literature review was performed between October 2015 and February 2016. Academic electronic databases were searched for the terms (1) "gamification" and "electronic health records," resulting in 125 articles; (2) "game design" and "electronic healthcare records," producing only two publications; (3) "gaming" and "electronic healthcare records," providing 40 studies; and (4) "gamification" and "healthcare records," yielding seven papers. These searches produced 204 scholarly articles, however only 170 were focused on gaming, gamification, and game design of EHRs. Figure 1 shows the results of the literature review search by year of publication.

Step 2: Literature Analysis

Using selected articles, we reviewed game design in the context of healthcare. Inclusion and exclusion criteria were as follows: Only articles published from 2007 to 2016 were utilized, and articles were restricted to sources attainable as full texts and written in the English language. Articles, reports, reviews, and research studies were included in this analysis.

The methodology and results of the identified texts were analyzed, and related papers were identified and included within the research collection. From a total of 170 references found, 46 research papers were used for this study, with the others excluded as too distantly related to the topic. The results were structured into categories consisting of game design elements. The literature search was conducted by three assessors and was validated by one, who acted as the second reader and also double-checked that the references met the inclusion criteria for the study.

Step 3: Literature Categorization

We reviewed the abstracts of the articles to determine if the topic was relevant to this study. If we determined that an article was relevant, the full-text content was analyzed and categorized on the basis of

the article's findings. Articles not meeting the categorization criteria were excluded. The categories are used below to organize the results of the study.

Results

A variety of game design topics were considered for this review because the gamification literature addresses many elements of gaming. This work explored game genres, game types, game motivations, and other game design attributes with the goal of understanding how game-related elements might contribute to the design of an EHR simulation game (EHRsim) for interprofessional education.

Existing Use of Gamification with EHRs

While many examples of simulation in healthcare settings such as anesthesiology,[19, 20] cardiology,[21, 22] intensive care,[23, 24] nursing,[25–27] obstetrics,[28, 29] outpatient healthcare,[30, 31] and many other disciplines[32] are available, few examples of gamification and simulation exist in the area of EHRs. One notable exception is the work of Mohan et al.,[33] who developed a case for simulation and provided six principles for consideration in EHR simulation. In a curriculum development study, Milano et al.[34] reported that a simulation curriculum can be effective in teaching EHR skills using a well-organized chart. Finally, Kuljis et al.[35] discussed how simulation in healthcare could benefit from a review of simulation in business manufacturing settings.

Game Genres and Types

Gaming researchers recognize differences in game types and genres,[36] and in our analysis we quickly realized the importance of these classifications. Genres such as fantasy, discovery, and serious games represent different styles of play. Game genres help to categorize games to support the design process and take advantage of similarities. Another categorization of games is game type, with each game type providing its own challenge and culture.[37] Some of the more common types are shooter, adventure, strategy, puzzle, athletic, and educational games. Game genre and game type are important in the design of an EHR simulation game because they can help designers optimize the game to address specific objectives and take advantage of similar, previously designed games.

Serious Games

While dictionary references provide a foundational definition of gamification, they often do not take into account the many different purposes or contexts in which games may be used. For example, some games are played entirely for fun, whereas serious games are played to learn something. Serious games incorporate an aspect of real-world learning or skill development and have been produced for use in a variety of fields, including medical education, retail, service industries, public safety, weight management, surgery, health education, and diabetes management.[38–42] Thus, serious games advance learning and skill development and may be enjoyable, but they also have a directed objective such as accelerating student learning. An EHR simulation game would be considered a serious game because students would learn a skill while playing.

Fantasy Games

Fantasy games provide virtual worlds, which many people prefer to reality.[43] Typically, designers use imaginary worlds with fantasy characters, graphics, narratives, and scenarios to create alternate realities in which only the fantasy world is relevant and users are insulated from consequences.[44–46] Although our search produced no fantasy games in the EHR arena, this aspect of simulation gaming is important in the healthcare fields because learning occurs without risk to the patient or the learner.

Although fantasy games provide an alternate reality, they can be designed to provide an analogy or metaphor for real-world processes that allows users to experience a variety of phenomena safely.[47, 48] In this way, the instructional content of serious games may be incorporated into fantasy games to increase student interest and learning of skills that would be difficult or dangerous to learn firsthand, such as in flight simulators, medical and surgical simulators, and firefighting and police shooting scenario games. In an EHR simulation, dangers to be simulated could include erroneous patient data, patient identification challenges, security breaches, accreditation audits, and other situations in which the actual risks are high.

Discovery Games

Problem-solving discovery games focus on engaging the user to apply skills and resolve difficult problems in complex environments.[49, 50] Translating multifaceted scientific problems into a puzzle creates a game that even nonexpert players can play to solve. A novice level in the game can be used to draw novices into explanations of the problem and support fun collaboration to achieve a solution. To address the difficulty of the problem to be solved, data visualization and graphics can be included to assist users in understanding the information and constraints associated with the game. Scoring and other extrinsic motivators should be comprehensive and include the latest discovery or scientific models. The processes associated with managing health information in an EHR are complex and offer many opportunities to practice problem-solving skills. A fully operationalized EHR simulation would likely combine features of serious, fantasy, and discovery games.

Intrinsic Motivation to Play

Motivation while playing games is important and has been studied by researchers. While fantasy and discovery are commonly seen in computer games, how strongly a participant engages in the game will drive learning.[51] Cordova and Lepper[52] suggest the inclusion of contextual material to support intrinsic or internal motivation. Intrinsic motivation is often viewed as connected to or similar to the concept of flow.[53] Other researchers believe that games can be designed to motivate users extrinsically or externally with no intrinsic connection between the game and learning.[54] However, Rieber[55] found that when an interesting game is purposely tied to learning content, the content itself becomes more interesting, thereby supporting intrinsic motivation. Examples of intrinsic rewards include game elements that support personal achievement, self-determination or drive, team play, and social relationships and networks; however, these rewards may only be effective until the individual goal is achieved.[56]

Extrinsic Motivation to Play

Game design characteristics have been found to influence extrinsic motivation.[57] Point rewards appear to be valuable because they provide immediate feedback in the process of obtaining an individual goal, thereby promoting competition.[58] Recognition-based awards such as badges, scoreboards, leader boards, progress bars, and level-of-progression scores are common examples of recognition of skill progress.[59] Such rewards advise others of a player's level of expertise.[60] These rewards serve to motivate users both intrinsically and extrinsically, potentially starting with external rewards to bring the user into the game in the hope that the content and joy of playing might then motivate the user internally.

Communities of Practice

Competition is often behind an individual's desire to play games with others and can increase a sense of accomplishment by allowing a player to demonstrate ability.[61] Researchers suggest that when accomplishment is shared in a "community of practice" in which players share understanding, values, and culture, the resulting social influence becomes a powerful motivational force for learning.[62] Social status becomes important as new users progress to become experienced insiders, helping newer players who seek guidance and providing an expertise ladder for all in the social network. Properly designed educational games can take advantage of this social influence advancing domain expertise.[63] By including communities of practice, game designers allow players to publicly proclaim their expertise, supporting social credibility and achievement.

Bonus Rewards

Well-designed games often include bonus rewards for achieving status or new levels. Often the reward for achievement is advancing to a more difficult level or activity to increase competency.[64] Bonus rewards represent a progression mechanism that increases the likelihood that certain activities will be repeated in future play.[65] These rewards may be informational or controlling.[66] Informational rewards will likely affect intrinsic motivation, whereas controlling rewards have the potential to introduce negative feelings in users. Therefore, bonus rewards add value by increasing competency via repeated activities and positively motivate players by means of progression and information.

Variety of Play

Another aspect of game design is related to the variety of play offered in the game. Because users are diverse, it makes sense to offer an assortment of mechanisms to involve them in a game.[67] Creating opportunities for users to tailor and personalize the game in a relevant fashion and introducing a method for users to share their customizations with others provides the optimum experience. Activities created by designers may not be meaningful to all players, so designers should include a variety of possible actions to attract dissimilar users. Moderately difficult challenges are motivating to users, particularly when they provide alternate routes to achieve success within the game.[68, 69] Therefore, designers offering variety in a game should not provide simple alternatives but instead develop challenging options. The objective is to offer a meaningful experience in which the user can demonstrate mastery of an activity through self-selection of activities in an adaptive environment.

Avatars

Many game designs take advantage of avatars. When coupled with concrete goal setting and transparency, avatar development allows users to identify with a self-selected persona.[70] Providing avatars in the game platform helps players to adopt roles and increase engagement. The user-created identity ties the user to game activities, helping the user connect in meaningful ways. Avatar toolkits improve the quality of the game and support social system use by players.[71] Clearly, avatar development enriches the game and encourages interaction between players. An EHR simulation may include many possible roles for a participant to assume. Avatars could be a mechanism to encourage participants to explore the various roles by taking on multiple personas.

Discussion

The use of gamification as a tool to engage learners in complex environments is growing, and this fact remains true in healthcare education.[72] Game design can take advantage of game genre, game type, serious games, fantasy games, discovery games, intrinsic and extrinsic motivation, communities of practice, bonus rewards, variety of play, and avatars to support learning related to EHR systems. Using game design elements in an EHR simulation might provide many benefits for health professionals, such as reducing errors and improving usability while accelerating learning. The American Medical Informatics Association Task Force on Usability[73] identified simulation as a valuable method for assessing the usability of EHR systems. The task force also identified several barriers to physicians' use of EHR systems, including the time required to learn the system, the level of understanding, and motivation. We believe simulation and other gamification techniques will enable and accelerate student learning related to EHR systems, in part by addressing these and other barriers.

Motivating learners is one area in which gamification may be especially effective. By supplementing or replacing traditional HIM curriculum exercises with an EHR simulation that tracks and continuously reports performance feedback related to objectives, game design may provide the benefit of instant gratification to which the current generation of learners has grown accustomed.

For some learners, competition with others is a source of motivation. An EHR simulation could provide a safe, controlled, and measured environment in which competition among learners would be harnessed and rewarded. If communities of practice and social networks are included, players motivated by social influences will become more engaged and choose to spend more time performing activities related to learning.

Not all learners will respond to the same types of motivation. Combining intrinsic and extrinsic motivation is key to engaging a broad range of learners in an EHR simulation. An EHR simulation should therefore include scoreboards, badges and points as well as interesting and dynamic content. Encompassing both internal and external game design elements for motivation will make the EHR simulation game fun and will inspire interest beyond the simulation and into the real world.

Limitations

This literature review was conducted by individuals with backgrounds in business, information technology, computer science, adult education, and healthcare who have gravitated to HIM education roles. Our perspectives are influenced by our enthusiasm for applying innovative technology toward the facilitation of effective learning.

This study involved the review of literature available via the Internet and through library research database subscriptions. While we believe the literature reviewed is sufficiently diverse to adequately represent the available body of knowledge, we recognize that other relevant sources likely exist beyond those we reviewed.

Conclusion

On the basis of our review of game design literature, we conclude that further research is warranted to explore the application of gamification and simulation of EHR systems to improve and accelerate learning. Clear evidence indicates that gamification and simulation can be effectively applied in a variety of learning environments, including higher education, workplace learning, and medical education. While graduate and undergraduate HIM students are the primary population of interest, we also see the potential for EHR simulation to be an effective learning approach for interprofessional education of healthcare practitioners.

This work suggests that HIM faculty, staff, and students might benefit from the development of an EHR simulation game that fosters team-based and role-based learning, encourages active versus passive learning, and provides a safe environment for building confidence while reducing practitioner risk.

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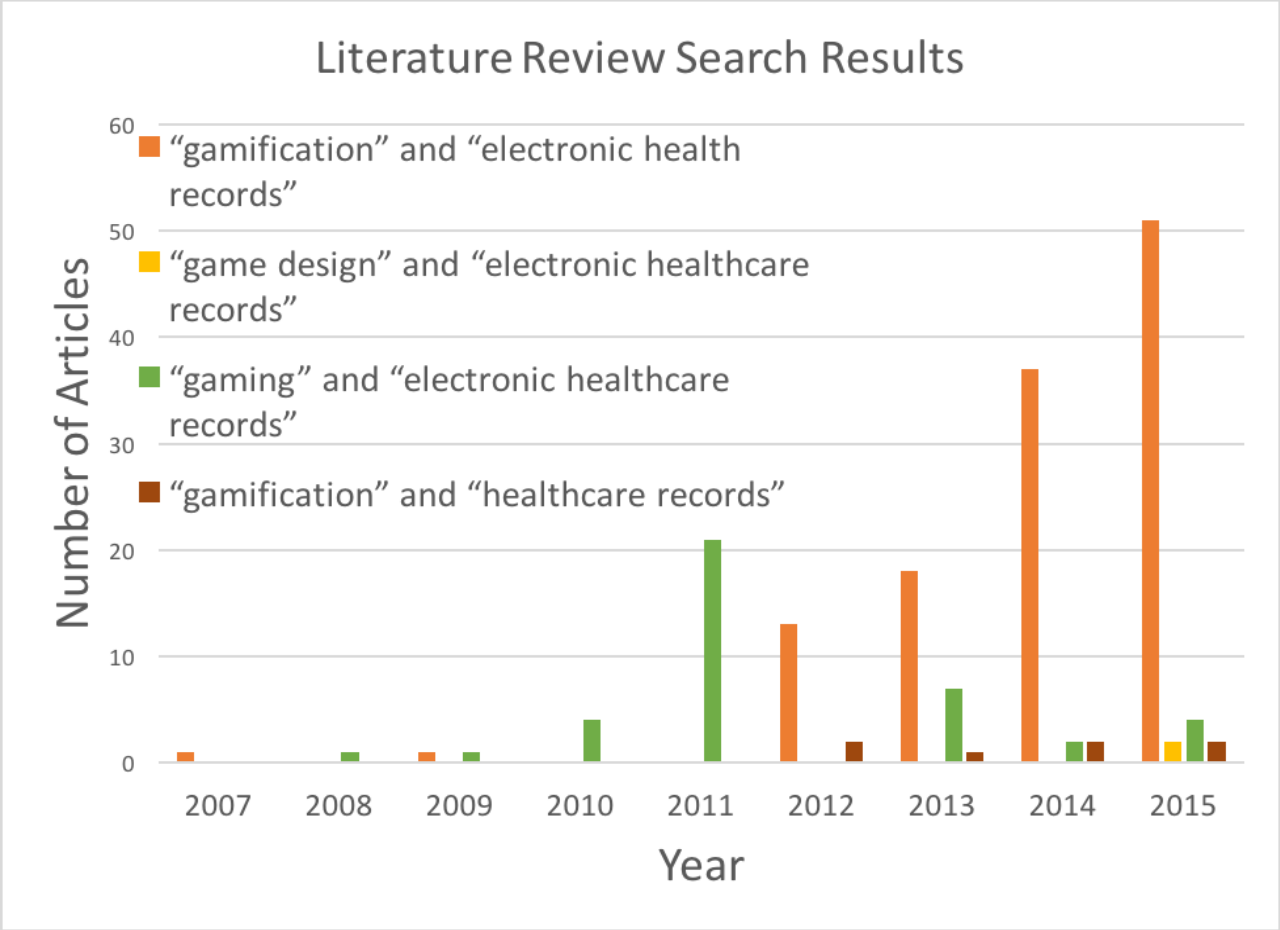
Figure 1


Literature Review Search Results
Number of Articles
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50
40
30
20
10
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"gamification" and "electronic health records"
"game design" and "electronic healthcare records"
"gaming" and "electronic healthcare records"
"gamification" and "healthcare records"
2007
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