Evaluating Motivation towards the EHR Simulation Game

Abstract

How we motivate people to engage and enjoy playing is an important concept in the creation of serious games focused on learning new skills. Experiential learning via simulation offers a variety of benefits including reduced risks, repetitive exposure and mastery of complex processes. This study sought to determine the motivators that increase user's pleasurable experience in a gamified Electronic Health Record simulation game. To examine how intrinsic and extrinsic motivation affected both engagement and enjoyment, we surveyed students of health professions at one university. Results indicate that while both forms of motivation are significant in increasing engagement and enjoyment, extrinsic motivation such as badges, points, scoreboards, etc. were much more important than internal motivations for our participants. These findings have implications for the development of an EHR simulation game.

Introduction

Digital health information maintained in EHR systems is an asset of significant value to both patients and healthcare organizations requiring governance by well-trained and experienced Health Information Management (HIM) professionals. Students who will become HIM professionals must develop competency and efficiency in a variety of complex processes governing health information which is the basis for clinical decisions that impact patient health. Health information must be accurate, complete, and available when and where needed for use in clinical and business decisions by all health professions. The terms *technology iatrogenesis* or *e-iatrogenesis* refer to errors that occur due to technology introduced into the already complex healthcare delivery system [1]. To minimize these errors, HIM professionals must achieve high levels of competency and efficiency through effective instruction and extensive practice. Issues with health information create substantial risks for patients, providers, and facilities. Furthermore, health information is highly targeted for compromise by perpetrators of medical identity theft as well as ransom [2]. Governance of health information addresses not only risks to patient health, but also risks to patient privacy. The challenges associated with health information governance are evolving rapidly and establish a need for new tools and methods to learn and practice in a safe, low-risk environment such as a simulation.

This article presents the results of a study examining health profession student's perceptions of game design elements and how they can increase user enjoyment when playing games. This study is based on the application of simulation and gamification techniques to enhance the experience of health profession students learning to use electronic health record (EHR) systems. Inspired by our previous experiences teaching complex systems and encouraged by literature about simulation in other areas of healthcare, the authors became curious about the effectiveness of a comprehensive simulation platform specifically designed to enable teaching and repetitive practice for the complex high-risk processes associated with EHR systems and how simulation game design might affect user enjoyment and engagement.

As a step toward understanding the potential for an EHR simulation platform, we conducted a survey of students in our college of health professions to explore game design elements, how

these elements motivate participants, and the positive effects on engagement and enjoyment. In the sections that follow, we first provide a review of literature that informed our research question. Next we review motivation and outcomes. Following the literature review, we describe our methods and results. We close with a discussion findings and conclusions drawn from the study.

Literature Review

Current gamification literature appraises a variety of elements associated with game design [3]. Game genres, types, motivations, and other game design characteristics are important in understanding specific game preferences and motivations that might contribute to the design of an Electronic Health Record simulation game (EHRsim). EHRsim is a simulation game under development. The purpose of the research was to discover what game design elements motivated HIM students from both an intrinsic and extrinsic perspective with the ultimate goal of making a simulation game engaging and enjoyable.

Gamification

While there are many examples of simulation and experiential learning in healthcare settings such as anesthesiology[4, 5], cardiology[6,7], intensive care[8, 9], nursing[10-12], obstetrics[13, 14], outpatient healthcare[8, 15], and many other disciplines[16], research on the combination of gamification and Electronic Health Records (EHRs) is sparse. A notable exception is Mohan et al.[1] which provided six designs for consideration in development of an EHR simulation. One curriculum development study reported that simulation might be helpful and effective in EHR instruction using a "well-organized chart" – defined as documenting actions reflecting current standards.[17] Additionally, Kuljis et al.[18] suggests that simulation in healthcare could benefit from a review of simulation in other settings such as business manufacturing.

Both game genre and game type should be considered in the design of an EHR simulation game as they allow designers to customize the game addressing specific learning objectives and taking advantage of analogous games that have already been designed.[19] Genres such as *fantasy*, *discovery*, and *serious games* need to be taken into account to support and frame the design process**.** Common categories of game types include shooter, adventure, strategy, puzzle, and sports games. While some games are played entirely for fun and entertainment, serious games are used as learning platforms, integrating aspects of real-world learning or skill development and have been created for a variety of purposes including medical education, retail, service industry, public safety, weight management, surgery, health education, and diabetes management.[20-24] A gamified EHR simulation game would be considered a serious game type because students would be engaged in learning and skill development, while playing to learn in an enjoyable, safe virtual environment.

Unlike serious games, fantasy games provide virtual worlds where many people opt to play, avoiding reality games.[25] Often times fantasy games are set in imaginary worlds and incorporate fantasy characters, graphics, narratives and scenarios, providing alternate realities. A large advantage of these imaginary worlds is that users are insulated from repercussions.[26-28] While our search did not reveal any previous works relating EHR to fantasy games, gamifying learning materials is particularly advantageous in the healthcare field as it facilitates learning while removing the risk of error that the patient and healthcare learner may experience in real-life

scenarios. With an EHR, real-life dangers that exist include erroneous patient data, patient identification challenges, security breaches, medication errors, and other situations—all of which can be safely practiced in a simulated environment while building both confidence and expertise. However, it is not only the safe environment that makes gamification appealing: increasing student engagement and enjoyment while learning new skills is also beneficial to learners.

Motivation, Enjoyment and Engagement

The motivation for playing is crucial to increasing player engagement and enjoyment and heavily studied by researchers. The extent to which a participant engages in games directly, correlates with learning outcomes [29]. Research suggests that a combination of both intrinsic and extrinsic motivation can be used to engage players [30]. Rieber [31] found that when an engaging game is intentionally connected to learning content, the content itself becomes more enjoyable. This, in turn, supports internal motivation or what is also referred to as intrinsic motivation [32, 33]. Game designs that support intrinsic motivation include elements supporting personal achievement, self-determination or drive, team play, social relationships and networks.[33-35]

In contrast to intrinsic motivation, extrinsic motivation uses external rewards to motivate the player [36]. Certain game design characteristics are suggested to directly impact extrinsic motivation.[29] Elements of game design increasing extrinsic motivation include the tracking of points and recognition-based rewards. Examples of recognition based rewards include badges, scoreboards, leaderboards, progress bars and level of progression scores.[37] Since the goal is to motivate players both intrinsically and extrinsically, extrinsic game elements might be used to initially engage the user with the expectation that the enjoyment of playing would then intrinsically motivate and engage the user long-term.[38, 39]

The end result of motivating participants is to engage in learning and produce greater academic outcomes.[43] People learn more quickly when engaged in content designed to be fun, resulting in deeper understanding, greater skill development, more confidence and greater achievement.[44] Engagement is often described as a heightened sense of concentration and great enjoyment is where people lose a sense of time and surroundings. This engagement phenomenon has been termed “flow theory” and it characterizes an enjoyable increase in interest and productivity.[45] Hence engagement is an important aspect of game design.

While engagement is important in gamification, so too is enjoyment.[46] Often enjoyment is overlooked, particularly in the completion of tedious tasks.[33] Motivation can increase enjoyment if game design elements are properly used to spontaneously generate student interest.[47] Self-determination theory proposes that people actively participate when supported and comfortably enjoying the acquisition of new experiences.[48]
According to this conceptualization, gamification can be seen to have three main parts: 1) the implemented motivational affordances, 2) the resulting psychological outcomes, and 3) the further behavioral outcomes.

In a systematic review, Hamari, Koivisto and Sarsa[49] conceptualized a structure for evaluating gamification by tying together a three part framework: the implemented motivation, the psychological outcome that resulted, and behavioral outcomes. Reviewing the gamification literature, they concluded that gamification leads to increased motivation, engagment and enjoyment.[49] Motivated participants are comfortable in learning new things, interested in the topic and enjoy the learning experience.

Research Questions

We crafted our research questions invoking the framework suggested by Hamari, Koivisto and Sarsa[49] shown in Figure 1.

Given the preceding review and the Motivation Outcome Framework, we sought to examine the following questions:

- How do extrinsic motivators affect people's engagement?
- What is the effect of extrinsic game motivators on participant enjoyment?
- What is the relationship between intrinsic motivators and participant engagement?
- How will intrinsic motivation impact a person's enjoyment?

Methodology

Many researchers have examined intrinsic and extrinsic motivations with the goal of improving performance, participation, engagement and enjoyment [30, 35, 47]. Methods for measuring these motivations have varied and historically researchers exploring intrinsic and extrinsic motivation, have created latent variable models and used a survey method. We formed a model fashioned after prior research to examine the relationships between perceptions of motivation and how it affects pleasurable use by decomposing motivation into two constructs—intrinsic and extrinsic motivation while incorporating two constructs of pleasurable use—engagement and enjoyment. Figure 2 details the relationship between intrinsic motivation, extrinsic motivation, engagement and enjoyment in our research model.

Procedures

We obtained Internal Review Board permission to operationalize our research design. To test this predictive model, we crafted a survey using the literature previously described and distributed it to students majoring in the College of Health Professions at a major public university in the southern United States. The college currently provides degree programs in Clinical Laboratory Science, Communication Disorders, Health Information Management, Healthcare Administration, Nursing, Physical Therapy, Radiation Therapy and Respiratory Therapy. Convenience sampling was used and an email was sent to these majors inviting them to take part in the online survey. Seventy-nine participants completed the survey shown in Appendix A. The Likert scale survey captured the items of interest related to intrinsic motivation, extrinsic motivation, engagement and enjoyment. Demographics of our respondents are included in Table 1.

Analysis

We used Partial Least Squares Path Modeling (PLS-PM) in RStudio to analyze the data following predictive modeling techniques.[50] PLS-PM analysis is now commonly used in

conducting latent variable research and provides a robust way of analyzing survey data.[51-54] To validate the psychometric properties of the measures, the Average Variance Extracted (AVE), Dillion Goldstein rho (DG ρ), Cronbach's Alpha (CA α) and Factor Loadings were calculated. Table 2 shows the AVE, DG ρ and CA for this model's constructs.

Although there is no standard method for calculating statistically acceptable composites, the generally accepted rule is for composite reliability to be greater than 0.7.[55] In this study, the lowest composite reliability was Engagement at 0.92 followed by Extrinsic Motivation at 0.95. Thus, composite reliability as measured by Dillion Goldstein's rho was greater than 0.9 for all constructs demonstrating sufficient reliability for all latent variables.

The factor loadings for the latent variables were calculated following Sanchez [50] using PLS-PM in RStudio. The factor loadings are provided in Appendix B. Validity of individual items was examined by verifying loadings greater than 0.7 for each construct. All items loaded at values greater than .70. Nine indicators loaded greater than .90, six loaded between .80 and .90 and two items loaded between .80 than .70. All items loaded greater "on-factor" than "off-factor" demonstrating good convergent and discriminant validity.

Results

The structural path model was formulated to test the motivators of pleasurable use framework. A bootstrap resampling method produced 500 samples in order to obtain the path coefficients and R^2 quantities. Statistical significance was then calculated for each path by calculating t-tests. Figure 3 shows the β coefficients and p values extracted via PLS-PM. The model accounted for a significant portion of variance in Enjoyment ($R^2 = 0.69$) and Engagement ($R^2 = 0.63$).

The coefficient or path value for Extrinsic Motivation toward Engagement was $\beta = 0.64$ with $p < 0.01$. Extrinsic Motivation to Enjoyment produced a $\beta = 0.66$ with $p < 0.01$. Intrinsic Motivation to Engagement was also significant with $\beta = 0.24$ and $p < 0.01$. Intrinsic Motivation to Enjoyment yielded a path value of $\beta = 0.27$ and $p < 0.01$. Table 2 reports our total effects findings for all participants in the survey including the Sample Mean, Standard Deviation, t Statistic and p Value.

Total effects indicate these relationships were significant. We performed a power analysis to determine how many respondents would be required for a medium effect size with a power of .80 at alpha .05 following Cohen [56]. Sixty-seven participants are required when analyzing two independent variables, thus with 79 valid responses we had adequate power for our study.

Discussion

This study quantitatively explores how intrinsic and extrinsic motivation impact individual engagement and enjoyment when playing games. The four research questions in this work explore how both intrinsic and extrinsic motivators increased whether an individual would be more engaged and/or enjoy learning while playing. The first research question sought to determine if these students were more likely to be engaged in electronic games if there were extrinsic motivators available. These students responded that extrinsic motivators would increase their engagement in electronic games.

The second question explored whether individuals would enjoy games more if extrinsic motivators were present. The students indicated that they would enjoy gamification if extrinsic motivators such as badges, scoreboards, and/or other reward systems were available. Thus it is important to include extrinsic motivators in electronic games when these games are used to teach EHR concepts.

The third research questions considered whether intrinsic motivation increases engagement in computer games. A person is intrinsically motivated when that person feels that an opportunity is fun or challenging. Intrinsic motivation occurs even in the absence of external rewards, and/or reinforcements. Students felt that being internally motivated would increase their engagement in games.

Finally, the fourth research question asked if intrinsic motivation affected a person's enjoyment of an electronic game. Internal motivation should provide support for individual enjoyment and pleasure when playing. This form of motivation drives the individual at a personal level.

The authors note that among our population of respondents, the extrinsic motivation scores (.66 and .64) are more than double the intrinsic motivation scores (.24 and .27) for both engagement and enjoyment. While the results for intrinsic motivators were not as high as those for extrinsic motivators, students still indicated that intrinsic motivators influenced whether they enjoyed games and would be engaged in playing games that had a learning element. To ensure that individuals use game-based learning tools, one must ensure that the incentives to learn are fun as well as challenging. These results provide interesting insights into how students perceive whether gamification can increase their engagement and enjoyment of learning electronic health record systems.

Anecdotally, we also asked our respondents why they play games. Forty-five reported playing games out of boredom, 40 play games for the mental challenge, 19 for social interaction, 18 for educational purposes, 2 for physical challenges and 10 for other reasons. We also asked participants about the types of games they play. In order of importance, puzzle, strategy, adventure, educational, multi-player, simulation, none, role-playing, shooter, athletic, platform, other and serious. Appendix C provides the counts by game type.

Conclusion

Teaching one to use EHR systems is a challenging task since the systems are large and complex requiring significant time to learn and practice. While we can be trained to use these systems, often this training lacks authenticity because it is presented in lecture or as a case study and the audience has little incentive to engage in learning the system. However, when gamification is used to teach systems, the learners are more inclined to engage with the technology for longer periods of time. Well-designed gamification motivates, increasing enjoyment and making learning by doing fun. The individuals who responded to this survey were more extrinsically motivated meaning that adding features such as badges, scoreboards, and/or other reward systems is more important than ensuring that the game is simply challenging or including the fun factor. This supports the view that gamifying EHR systems would be beneficial to our target audience.

Limitations

This paper has several limitations. First, this study used students from a single department within a single college of a university. However, since the study was focused on HIM professionals and the survey was completed by HIM students near completion of their program of study, these students are a good representation of early-career HIM professionals. Early-career HIM professionals often hold jobs requiring them to engage with EHR system.

Second, this paper proposes implementation of an EHR simulation game; however, we question whether the results would differ after playing the game. These results were based on responses to a survey. We question whether the results would be similar in a different type of study such as an experiment with an actual EHR simulation game.

Third, there are other factors which affect a person's gaming engagement and enjoyment. The chosen motivations do not represent all factors affecting the dependent variables and other more important impacts remain undetermined. This study was therefore limited by the selection of the included variables.

Future Research

While this paper studied whether both intrinsic and extrinsic motivation influenced one's engagement and enjoyment in a gamified learning environment, there are other antecedents such as self-efficacy or voluntariness that should be explored as well. Future research should explore whether results would be different based on gender and/or ethnicity. Another thought is that the current model explores whether intrinsic and extrinsic motivators are both antecedents of enjoyment and engagement; however, could extrinsic motivators actually be antecedents to intrinsic motivators. Finally, this research might benefit from an extension of the research model to include other behavioral outcomes such as intention to use and technology acceptance.

Notes

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Appendix A

Survey

ENG1	I would be interested in learning a skill by playing computer games.
ENG2	I would be more productive if my work were made more game-like.
ENJ1	Gamification would make electronic health record systems more fun.
ENJ2	Gamification would make electronic health record systems more interesting.
ENJ3	I would be comfortable playing an electronic health record game.
EXT1	A computer game should contain numerous levels or areas that can be explored.
EXT2	If small rewards were given for gaining a certain amount of points, I would return to a computer game more often.
EXT3	A computer game can be made more fun by adding challenges.
EXT4	I prefer playing computer games with strong communities that have social components.
EXT5	When playing a computer game, I would enjoy being awarded expert user status.
EXT6	I would use a computer game more often if I were awarded points for performing different tasks.
EXT7	When playing a computer game, I would enjoy collectable online badges.
EXT8	In a game based electronic health record, I would enjoy an accumulation of points for accomplishing objectives.
EXT9	In a game based electronic health record, I would enjoy the ranking of players in a game.
EXT10	In a game based electronic health record, I would enjoy the tracking of player statistics.
EXT11	In a game based electronic health record, I would enjoy the ability to play the game with others.
EXT12	In a game based electronic health record, I would enjoy the use of graphics to indicate levels of completion.
EXT13	In a game based electronic health record, I would enjoy badges awarded as recognition for accomplishments in a game.
INT1	I welcome the introduction of new technology in my studies.
INT2	I consider myself to be “open” to new practices that are introduced in my studies.
INT3R	I would rather new technology not be introduced in my studies.
INT4R	I am generally resistant when new ways of working are introduced in my studies.
INT5	I am willing to learn new skills to take advantage of new technology that is introduced in my studies.
INT6	I look forward to the advantages brought by new practices that are introduced in my studies.

Appendix B
Factor Loadings

	Extrinsic	Intrinsic	Engagement	Enjoyment
1 EXT1	**0.88**	0.54	0.79	0.76
1 EXT2	**0.79**	0.43	0.70	0.64
1 EXT3	**0.85**	0.43	0.60	0.63
1 EXT4	**0.80**	0.31	0.55	0.51
1 EXT5	**0.77**	0.32	0.53	0.54
1 EXT6	**0.85**	0.43	0.60	0.72
1 EXT7	**0.84**	0.50	0.64	0.74
1 EXT8	**0.83**	0.36	0.58	0.69
2 INT1	0.48	**0.94**	0.58	0.56
2 INT2	0.55	**0.96**	0.56	0.61
2 INT3	0.45	**0.93**	0.47	0.56
2 INT4	0.43	**0.92**	0.50	0.55
3 ENG1	0.74	0.56	**0.93**	0.71
3 ENG2	0.66	0.47	**0.91**	0.73
4 ENJ1	0.78	0.56	0.77	**0.96**
4 ENJ2	0.77	0.58	0.76	**0.96**
4 ENJ3	0.73	0.60	0.68	**0.92**

Appendix C
Type of Games Played

Puzzle	Strategy	Adventure	Educational	Multi-player	Simulation	None	Role-playing	Shooter	Athletic Sports	Platform	Other	Serious
36	35	27	24	22	15	14	14	14	9	6	6	5
16%	15%	12%	11%	10%	7%	6%	6%	6%	4%	3%	3%	2%

Figure 1
Motivation, Outcome Framework

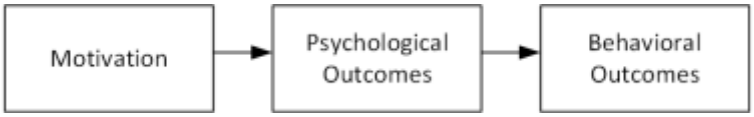

Figure 2
Motivators of Pleasurable Use

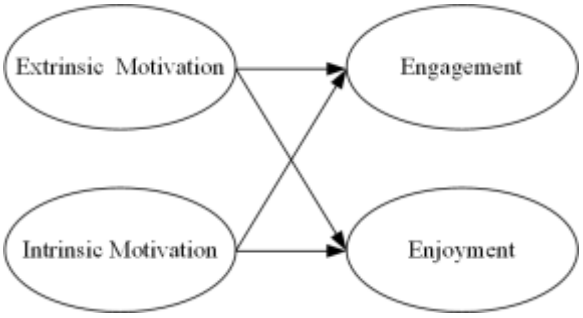

Figure 3

Motivators of Pleasurable Use Results

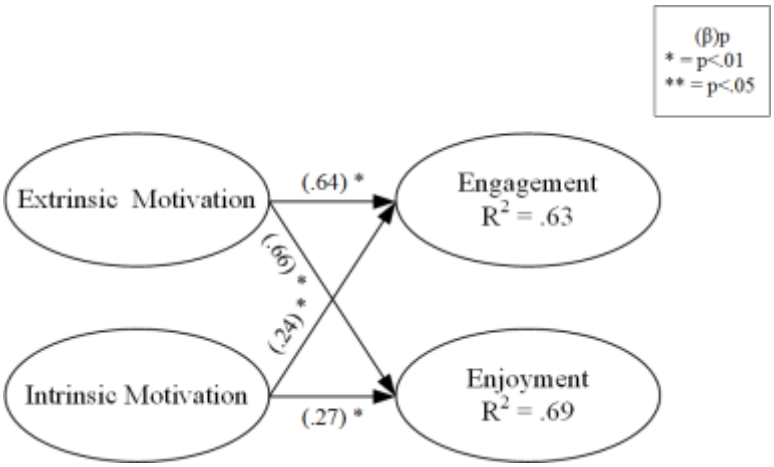

Table 1
[no title provided]

Ethnicity	**N**	**%**
White/Caucasian	44	56%
Hispanic/Latino	17	22%
Black/African American	6	8%
Asian/Pacific Islander	6	8%
Other	5	6%
Pacific Islander	1	1%
Gender		
Female	64	81%
Male	15	19%
Major		
Health Information Management	31	39%
Nursing	28	35%
Physical Therapy	8	10%
Healthcare Administration	6	8%
Clinical Laboratory Science	3	4%
Respiratory Care	2	3%
Radiation Therapy	1	1%

Table 2
AVE, DG ρ, and Cronbach's Alpha α

Construct	AVE	DG ρ	CA α
Extrinsic Motivation	0.68	0.95	0.93
Intrinsic Motivation	0.88	0.97	0.95
Engagement	0.85	0.92	0.82
Enjoyment	0.90	0.96	0.94

Table3
Total Effects

Relationship	Sample Mean (M)	Standard Deviation (STDEV)	t Statistics (|O/STERR|)	p Value
Extrinsic→Engagement	.64	0.08	7.87	.01
Extrinsic→Enjoyment	.66	0.07	8.93	.01
Intrinsic→Engagement	.24	0.08	2.90	.01
Intrinsic→Enjoyment	.27	0.07	3.71	.01