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All Work and All Play? A Framework to Design Game-based Information Systems

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Abstract:

Organizations have increasingly sought to develop and use game-based information systems to increase engagement among employees or customers. However, many game-based information systems have failed due to poor design. Game-based information systems' design must align with an organization's need or problem and users' motives. To help designers create game-based information systems that align with an organization's needs, we present the game-based system design framework (GSDF). Designers can use this framework to select game-based elements to support aesthetics, dynamics, and mechanics to encourage intrinsic or extrinsic motivation among users. We also create a game-based system design diagram (GSDD) and process in the spirit of UML diagrams for designers to communicate game-based information system designs. We explain how one can use the GSDF and GSDD and their value for practice and research.

Keywords: Game-based Information Systems, Game-based Information System Design, Gamification, Serious Games, MDA, Self-determination Theory, Motivation.

Fiona Nah was the accepting senior editor for this paper.

1 Introduction

In organizations, incorporating game-based elements in work processes can increase employee productivity by 87 percent, engagement by 84 percent, and happiness by 82 percent (Zoe, 2018). In employee training contexts, game-based information systems (IS) enable employees to retain 11 percent more facts and 14 percent more skill-based knowledge than employees who do not use a game-based IS during training (Zichermann & Linder, 2013). Organizations have increasingly incorporated game-based elements into non-gaming contexts (Deterding, Khalid, Nacke, Dixon, 2011; Landers, 2014; Silic & Lowry, 2020) to introduce play elements in the workplace. Organizations must design game-based IS to enable users to achieve the former's utilitarian goals while simultaneously allowing the latter to indulge in hedonic digital elements that support their personal needs, motives, and goals (Suh & Wagner, 2017).

Simply adding play elements to a utilitarian system rarely constitutes enough to achieve a successful outcome with game-based IS (Ferrara, 2012; Zichermann & Cunningham, 2011). Despite the interest among organizations to gamify IS, many systems fail due to poor design (Morschheuser, Werder, Hamari, & Abe, 2017). Recent papers have encouraged scholars to focus more intently on designing game-based IS. Lowry, Petter, and Leimeister (2020) encourage more intentional design interface choices for game-based IS since these decisions create intended and unintended consequences for users. A recent literature review identifies concerns regarding the lack of research that has examined designers' intentions when creating game-based IS (Khan, Boroomand, Webster, & Minocher, 2020).

Increasingly, research related to game-based IS has also encouraged designers to consider the context of these systems. Integrating game-based thinking into information system design requires designers to move beyond creating a game to developing "a meaningful strategy that has real-world effects and impacts on users' motivation and behavior" (Calderón, Boubeta-Puig, & Ruiz, 2018, p. 239). For example, game-based IS for training employees must incorporate game-based elements differently from enterprise systems that introduce game-based elements to achieve higher levels of organizational efficiency. Recent papers offer exemplars for designing rich and useful game-based IS to meet specific organizational needs, such as training employees on IS security practices and policies (e.g., Silic & Lowry, 2020) or predicting sales performance (Rocha, Pereira, & de Jesus Pacheco, 2020).

We created the game-based system design framework (GSDF) to help designers design game-based IS. Although several frameworks offer suggestions for designing game-based IS (e.g., Liu, Santhanam, & Webster, 2017; Ruhi, 2015), scholars and designers require more knowledge to identify how specific game-based elements support or inhibit the alignment between the design of a game-based IS and an organization's intended purpose for the system. The GSDF, with roots in game design (Hunicke, LeBlanc, & Zubek, 2004) and psychology (Ryan & Deci, 2000a), helps system designers identify what design elements to select to motivate users to engage with a game-based IS. We also demonstrate how one can visualize a game-based IS's design using the game-based system design diagram (GSDD). The GSDD is a visualization and communication tool to confirm that the game-based elements that designers choose when using the GSDF coincide with their organization's intentions for the system and users' motives.

This paper proceeds as follows: in Section 2, we provide background information related to the existing literature on game-based information systems in organizations, designing game-based information systems, and user motivation in the game-based IS context. In Section 3, we describe the game-based development framework (GSDF). In Section 4, we demonstrate how to apply the GSDF using a game-based system design diagram. In Section 5, we explain how the GSDF and GSDD relate to existing research and offer insights for research and practice. Finally, in Section 6, we conclude the paper.

2 Background

2.1 Game-Based Information Systems

Applying game elements to non-gaming contexts became popular in educational contexts during the 1980s (Dale, 2014). Since that time, organizations have increasingly created and adopted game-based IS. As a result, scholars have examined game-based approaches to support consumer engagement (Xu, Buhalis, & Weber, 2017; Xu et al., 2013), employee performance (Cardador, Northcraft, & Whicker, 2017; Warmelink et al., 2018), employee engagement (Lawande, Mohile, & Datta, 2016; Mollick & Rothbard, 2014; Neeli, 2012; Swacha & Muszyńska, 2016), and employee recruitment, retention, and training (Depura & Garg, 2012; Joy, 2017; Lowman, 2016).

Organizations have many options to gamify IS to bring play elements into the workplace. Some organizations create serious games (i.e., game-based IS that provide entertainment value while informing and instructing the user during gameplay) (Abt, 1987). Other information systems embrace simulation elements, which replicate real-world elements but may or may not include game-based elements in their design (Marczewski, 2015). Gamification constitutes a widely used term that researchers often simply describe as using “game design elements in non-game contexts” (Deterding et al., 2011, p. 2). However, this broad definition does not specifically pertain to gamifying information systems. Other scholars have defined gamification in a more contextualized and richer way by considering users’ motivations and information’s role. For instance, Treiblmaier, Putz, and Lowry (2018) define gamification as “using game-design elements in any non-game system context to increase users’ intrinsic and extrinsic motivation, help them process information, help them to better achieve goals, and/or change their behavior” (p. 134). Rather than distinguishing among the various approaches that organizations have used to introduce playful elements in an organizational context, some scholars have adopted umbrella terms, such as game thinking (Armstrong, Landers, & Collmus, 2015; Marczewski, 2015), to describe the idea of integrating game elements into organizational processes.

We define an information system that incorporates any form of game thinking or game-based elements as a game-based IS. As an organization incorporates game-based elements in an IS, it creates a persuasive system to align users’ motives and goals with its own needs or goals (Blohm & Leimeister, 2013). Such an organization may seek to engage external users (e.g., customers, suppliers) or internal users (e.g., employees) to achieve specific goals. For example, Tripadvisor uses an externally facing game-based IS to encourage users to engage with its website (Xu et al., 2017, 2013). Internally, organizations have created game-based IS by including goals, objectives, multimedia feedback, and fictional representations to improve employee motivation, enjoyment, flow, and performance in production and logistics contexts (Warmelink, Koivisto, Mayer, Vesa, & Hamari, 2018). Whatever the reason for which an organization creates a game-based IS, a game-based approach does not constitute the end result but rather a tool to allow the organization to motivate users to engage with information systems differently (Freudmann & Bakamitsos, 2014; Lucassen & Jansen, 2014).

The game-based elements an organization chooses and how it designs them affects how individuals use and interact with a game-based IS and the organization itself (Lowry et al., 2020; Khan et al., 2020). Designing game-based IS involves considerable challenges because “no single gamified system can cater to all users—rather, the system should be capable of providing multiple gratifications to users, and offer features and functions that are aligned with various types of employee motivations to use the system” (Ruhi, 2015, p. 7). Although game-based IS can “champion and harness the innate potential of the employees in the organization” (Lawande et al., 2016, p. 197), introducing game-based elements in all organizational information systems does not constitute a panacea. Game-based IS fail when they are “done for appearances rather than with real benefits to organizations” (Epstein, 2013, p. 14).

2.2 Designing Game-based Information Systems

2.2.1 Mechanics, Dynamics, Aesthetics (MDA)

One widely known framework in the video gaming research community—the mechanics, dynamics, and aesthetics (MDA) framework—communicates game design elements among stakeholders, such as designers, programmers, critics, and researchers (Hunicke et al., 2004). MDA explains video games by separating 1) a system’s design or control mechanisms (mechanics), 2) the interactions between users and the system (dynamics), and 3) users’ emotional response to the game (aesthetics) (Hunicke et al., 2004). The aesthetics component focuses on the desired feelings or emotions that users should sense through the gameplay, such as enjoyment or curiosity. A game’s dynamics, which include the actual conditions in the game (e.g., defining how players cooperate with others, creating means to incite tension or release while playing, or receiving feedback within the game), evoke the aesthetics. The mechanics create these dynamic elements; that is, “the various actions, behaviors and control mechanisms afforded to the player within a game context” (Hunicke et al., 2004, p. 3), such as rules or game content that provide structure for the game.

MDA explains how video games function “as dynamic systems [which] help us develop techniques for iterative design and improvement—allowing us to control for undesired outcomes, and tune for designed behavior” (Hunicke et al., 2004, p. 5). Researchers have applied MDA as a framework in other contexts beyond video games to describe the design of virtual worlds (Cowley, Charles, Black, & Hickey, 2008;

Franceschi, Lee, Zanakis, & Hinds, 2009), gamification (Deterding et al., 2011; Kim, 2015; Ruhi, 2015), and serious games (Nacke, Drachen, & Göbel, 2010; Westera, Nadolski, Hummel, & Wopereis, 2008). Researchers have also adapted MDA for different research needs. In a serious game context, Winn (2008) adapted MDA in the design, play, experience (DPE) framework in which design incorporates mechanics, play is a function of dynamics, and experience is associated with aesthetics. Others have repositioned MDA as the mechanics, dynamics, emotions (MDE) framework in which “emotions are the mental affective states and reactions evoked among individual players when they participate in a gamified experience” (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015, p. 416). By focusing on emotions rather than aesthetics, the MDE framework enables a more intentional focus on the emotions generated due to engaging with a game-based IS (Mullins & Sabherwal, 2020; Robson et al., 2015).

In their literature review, Azmi, Iahad, and Ahmad (2015) examined how past research has applied the MDA framework in the gamification context and found that most research focused on mechanics and dynamics but paid little attention to aesthetics. Researchers have focused less on aesthetics because one can consider the concept “ambiguous” and “very broad” (Fernández-Vara, 2009, p. 6). Yet, perceived aesthetic experience strongly predicts whether users will adopt certain types of game-based IS (Wang, Goh, Lim, & Vu, 2016). By referring to emotions rather than aesthetics, the MDE framework (Robson et al., 2015) has encouraged a specific focus on game-based IS designs to include this emotional gameplay and interaction dynamic (Mullins & Sabherwal, 2020).

The “additive-deterministic design paradigm” constitutes one problem that research examining game-based IS has faced (Deterding, 2014, p. 319). This paradigm assumes that adding game-based elements can sufficiently stimulate and engage users with game-based IS. In recently reviewing game-based IS in organizational settings, Khan et al. (2020) found that many studies strongly emphasized game-based elements as opposed to systems’ overall holistic design. MDA (Hunicke et al., 2004) or MDE (i.e., its more recent evolution) (Robson et al., 2015) offer a means to examine how to design an information system using multiple game-based elements in a more comprehensive manner. Therefore, we integrate concepts from MDA with other knowledge about game-based information systems to provide guidance regarding how to combine game-based elements to create an interactive and engaging user experience that accomplishes an organization's goals.

2.2.2 Game-based Elements

Game-based elements constitute the building blocks that introduce the game-like aspects in an information system to evoke emotion, specify how users interact with the game or other players, and/or engage the user in a meaningful way. The gamification literature includes many studies that list game-based elements. Common game-based elements include levels, leaderboards, badges, and timers, and some research seeks to classify game-based elements into categories (e.g., Robinson & Bellotti, 2013). However, attempts to identify and classify game-based elements often result in criticism that, for example, researchers developed taxonomies solely from the extant literature or developed taxonomies that have an overly narrow focus (Meder, Rapp, Plumbaum, & Hopfgartner, 2017). Our game-based design framework incorporates multiple taxonomies of game-based elements to demonstrate how designers can select game-based elements to address an organization's needs.

2.2.3 User Motivation

Many studies have examined how users' motivation predicts IS use or outcomes (e.g., Rode, 2016; James, Wallace, & Deane, 2019). As persuasive systems, game-based IS motivate users to engage with them to achieve an organization's intended goals (Blohm & Leimeister, 2013). One specific motivation theory, self-determination theory (SDT), enables scholars to explore research questions related to users' motivations and how they use game-based IS (Treiblmaier et al., 2018, Xi & Humari, 2019).

Motivation refers to the feeling or stimulus that drives one to engage in an action, and one's degree or level of motivation, one's persistence in continuing in the action, and one's reasons to act vary across tasks and individuals (Ryan & Deci, 2000a, 2000b). Self-determination theory (Deci & Ryan, 1985) explains this variation in motivation among individuals by focusing on individuals' needs and reasons for self-motivation (Ryan & Deci, 2000a). SDT contains two major reasons or sources for motivation: intrinsic motivation and extrinsic motivation (Ryan & Deci, 2000b). When individuals have a desire to act due to intrinsic motivation, they do so “to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn” (Ryan & Deci, 2000a, p. 70). In contrast, when individuals have a desire to act due to extrinsic

motivation, they do so to obtain an outcome (Ryan & Deci, 2000b), such as using an information system to avoid a reprimand or to ensure others view them positively¹.

In the game-based IS context, researchers have focused on finding ways to use game-based elements to increase individuals' intrinsic motivation toward using an information system (e.g., Treiblmaier et al., 2018, Silic & Lowry, 2020). Prior research has demonstrated that rewards offered to simulate extrinsic motivation among game-based information systems users tend to decrease in effect over time and simultaneously negatively impact users' intrinsic motivation (Perryer, Celestine, Scott-Ladd, & Leighton, 2016; Xi & Hamari, 2019). Therefore, the game-based elements that designers select when designing a game-based IS can influence users' motivations toward the system.

Scholars have identified some game-based elements that are more likely to support intrinsic or extrinsic motivation (Robinson & Bellotti, 2013). Yet, skepticism regarding the value of supporting extrinsic motivation in the game-based IS context remains (Kapten & Nacke, 2013). Some scholars have expressed concern that many game-based elements that support extrinsic motivation focus more on work and game-based elements that support intrinsic motivation focus more on pleasure (Perryer et al., 2016). While some empirical studies have examined how specific game-based elements (e.g., leaderboards, badges, combat) influence intrinsic motivation (e.g., Buckley, Dewille, Exton, Exton, & Murray, 2018; Kumar & Herger, 2013), more opportunities exist to examine how one can include or exclude game-based elements from an information system to affect a user's intrinsic or extrinsic motivation toward the system (Seaborn & Fels, 2015).

An organization needs to consider which game-based elements it selects and implements in a game-based IS to ensure that they promote intrinsic and extrinsic motivation and, thus, motivate users to use the system and achieve the organization's goals (Gears and Braun, 2013; Liu et al., 2017). Many game-based elements may intrinsically or extrinsically motivate users depending on the how one operationalizes the elements in a game-based IS and the needs or nature of the users who interact with the elements. Thus, game-based IS designers should carefully consider how these systems "feel" as they seek to engage and motivate users. In Section 3, we explain how designers can work toward this goal with our game-based system design framework.

3 Game-based System Design Framework

To create the game-based system design framework (GSDF), we classified game-based elements as mechanics, dynamics, or aesthetics based on definitions that the MDA framework provides (Hunicke et al., 2004). Beyond classifying game-based elements as mechanics, dynamics, or aesthetics, we considered how one could use game-based elements in different combinations to support the overarching goals for a game-based IS.

Unlike other game-based IS frameworks (e.g., Ruhi, 2015; Liu et al., 2017), the GSDF requires that designers first identify the appropriate aesthetics for a game-based IS. By selecting aesthetics as opposed to mechanics first in the game element-selection process, designers can ensure that the chosen dynamics and mechanics complement the "feel" they intend the game-based IS to evoke. Aesthetics constitutes a critical game-based IS component in that it affects users' emotional response to these systems (Mullins & Sabherwal, 2020). Game-based IS can be persuasive technologies that attempt to encourage users' behaviors by incorporating game elements (Blohm & Leimeister, 2013). The chosen aesthetic game-based elements can promote users' intrinsic and/or extrinsic motivations to use these systems. Understanding an organization's problem and users' motives for their behaviors can help designers identify which aesthetics they should include in a game-based IS.

¹ Self-determination theory also contains multiple subtheories that further explain the factors that affect intrinsic motivation or subdimensions of extrinsic motivation, which includes factors that support intrinsic motivation, such as autonomy, competence, and relatedness (Deci & Ryan, 1985). We have limited our discussion to the intrinsic and extrinsic motivation concepts in this research effort; however, in the discussion, we identify opportunities to expand on how researchers have previously integrated SDT in game-based IS.

Table 1. Game-based Elements Identified as Aesthetics

Game-based element*	Motivation	Definition	Example of implemented game-based element
Challenge ^{a, b, c}	E/I	A game's ability to encourage players to embrace difficult tasks to bring pleasure or enjoyment through obstacle courses or trials.	Players must use decision-making and/or problem-solving skills to successfully complete the game.
Cognizance ^c	E/I	A game as a mechanism for increasing one's awareness and understanding of their organizational environment.	Players better understand the organizational culture from interactions with other employees through using the system.
Confidence ^c	I	A game as a mechanism to enable an individual to improve their belief in one's abilities or skills.	Players increase their belief in their people skills through improved interactions with other players within the system.
Discovery ^{a, b, c}	I	A game's ability to simulate a personally motivated desire to explore uncharted territory in the world or game.	Piques players' desire to do more in the game.
Entertainment ^{a, b}	I	A game's pastime aspect to provide the ability to escape or experience pleasure through gameplay.	Player can immerse themselves in the game and lack concern for real-world situations.
Narrative ^a	I	A game's drama aspect.	Player reads all of the storyline that the system provides.
Sensation ^a	E/I	A game's sense-pleasure.	The system exposes players to various sights and sounds.
Fantasy ^a	E/I	A game's make-believe aspect.	Players create an avatar that may differ from themselves in real life.
Personal returns ^{a, b}	E/I	A game as a mechanism for self-discovery and benefits that increase one's wealth, health, and achievements and/or that help one avoid negative consequences due to gameplay.	Players implement positive lifestyle changes based on information that they learned about personal health from a game-based information system.
Social reward ^{a, b, c}	E/I	A game's social framework. It helps users develop a sense of membership or camaraderie in a group or to avoid negative social consequences.	Player joins in-game groups that meet regularly in game to engage in activities.
Societal returns ^{b, c}	E/I	Benefits to the greater society for engaging in the activity, such as saving the environment, creating political awareness, or other socially constructive behaviors	Players recycle more based on information they learned in a game-based information system.
Commendation ^c	E	Recognition for accomplishments in a game	Players can display the results of their activities or achievements, such as a certificate of completion.
Compliance ^b	E	A game affords employees the capabilities to meet organizational standards and requirements.	Players complete required training in the system.

* In this column, "a" refers to Hunnicke et al. (2004), "b" to Robinson & Bellotti (2013), and "c" to Ruhi (2015).

In Table 1 above, we identify game-based elements from Hunnicke et al.'s (2004), Robinson and Bellotti's (2013), and Ruhi's (2015) taxonomies that concur with how the MDA framework defines aesthetics. We define and provide examples of these game-based elements in the table. We also identify if the game-based element is more likely to encourage either intrinsic (I) or extrinsic (E) motivations. Since intrinsically motivated individuals feel "moved to act for the fun or challenge entailed rather than because of external

prods, pressures, or rewards" (Ryan & Deci, 2000b, p. 56), aesthetics such as "discovery" or "entertainment" naturally fit the classification of an aesthetic that supports intrinsic motivation. In contrast, individuals perform aesthetics such as "compliance" or "commendation" "in order to attain some separable outcome" (Ryan & Deci, 2000b, p. 60), which suggests that these aesthetics support extrinsic motivation. However, several game-based elements can support both intrinsic and extrinsic motivations (E/I)² depending on how designers implement the aesthetic in a game-based IS.

Focusing on aesthetics first when designing game-based information systems concurs with Mullins and Sabherwal's (2020) recommendation that "designers [should] first consider *the desired emotional outcomes, and that those considerations should play a role in the mechanics (i.e., setup, rule, and progression) and target dynamics of the gamified experience*" (p. 308, emphasis in original). In the GSDF, aesthetic elements constitute requirements that drive designers to choose game-based elements that support a game-based IS's dynamics and mechanics.

After choosing the aesthetics, designers need to select complementing dynamics to support the desired aesthetics. They use dynamic game-based elements to identify how users will interact with the system and how the system will respond to users' actions.

We identify game-based elements in Table 2 from Hunicke et al. (2004), Robinson and Bellotti (2013), and Ruhi (2015) that concur with how the MDA framework defines dynamics. We define and provide examples of these dynamic game-based elements in the table. To guide designers who need to identify dynamics consistent with the chosen aesthetics, we identify the aesthetics that each dynamic game-based element would likely support. For example, if designers chose the challenge aesthetic for a game-based IS, then they could incorporate dynamics such as performance comparisons, available game accomplishments, difficulty, opponent play, chance, consequence, constraints, time pressure, and/or visibility/accountability in the system to support it. With this knowledge, designers could make more deliberate choices regarding the dynamics that they incorporate in game-based IS.

Table 2. Game-based Elements Identified as Dynamics

Game-based element*	Definition	Example of implemented game-based element	Supported aesthetics
Performance comparisons ^b	Ability to compare one's self to others in the game using scores or rankings.	A leaderboard.	Challenge, social reward.
Records for total game achievement ^b	Ability to examine one's in-game performance framed over time.	Longitudinal scores that aggregate game data such as total number of data found, total number of hours playing, average time to complete a module, etc.	Confidence, personal returns.
Ambiguity to reach objective ^{a, b, c}	Objectives that require assistance from other players. Degree to which it is obvious in terms of the cues about the activity that one needs to complete.	Puzzles, mazes, mysteries, riddles, clues, and locks.	Social reward, confidence, cognizance, societal returns, compliance.
Available game accomplishments ^{b, c}	Different forms of accomplishments that one can obtain in a game. Options about which options one can take in a game.	Scores, levels, learning, finding items, completing quizzes.	Challenge, discovery, cognizance, fantasy.

² For each game-based element in Table 1, we classified motivations as intrinsic, extrinsic, or both extrinsic and intrinsic using two methods. First, some taxonomies, such as Robinson and Belotti's (2013) taxonomy, identify some game-based elements as supporting intrinsic or extrinsic motivation. Second, we each independently coded the aesthetics game-based elements. We discussed how we coded each element, and, if we could identify scenarios in which a game-based element could support intrinsic or extrinsic motivation, we coded the motivation as "E/I". If we could identify only scenarios that could support either intrinsic or extrinsic motivations, we coded these items as "I" or "E", respectively.

Table 2. Game-based Elements Identified as Dynamics

Difficulty ^{b, c}	Changes to a game's difficulty over time to encourage engagement and flow. Moving through the stages/choices in the game.	Number of items needed to complete a module increases as the player's level increases	Challenge, confidence, entertainment.
Completion status ^{b, c}	Ability to identify how much of a game one has completed.	A progress bar with a message that says "Your game is 35% complete".	Commendation, confidence.
Leave a mark ^a	Ways for players to add unique content/contributions to a game.	A player can alter the game environment by leaving an item in the world that other players will see as they play.	Personal returns.
Opponent play ^{a,b, c}	Game-based goals in a game.	Missions, tasks, questions, puzzles, or competition against other players.	Challenge, cognizance, confidence, compliance, societal returns, discovery.
Records of achievements ^b	Feedback mechanism to display and record achievements throughout a game.	Individual achievements such as badges or trophies, points, ratings, or levels.	Confidence, personal returns.
Relationships ^{a,b,c}	Ability to develop and support different relationships.	Playing with partners or friends, developing a team, and working as a cohort.	Social reward, societal returns.
Renewal/ regeneration ^b	Ability to play the game again after failed attempts (or death of a character).	Being revived by a teammate after one's character dies from failing OSHA training.	Entertainment, social reward, fantasy.
Chance ^c	Random events that happen in the game.	A particular task only shows on the screen at random intervals.	Challenge, narrative, discovery.
Consequences ^c	Results that occur from taking actions in a game (good or bad).	Receiving a promotion for completing a set of tasks.	Challenge, confidence, cognizance, compliance.
Constraints ^c	Limits that restrict player actions in a game.	A player can only enter a certain area if they have reached a high enough level.	Challenge, narrative, discovery.
Time ^b	Ability to save time—whether minutes, hours, or days.	A player uses a potion to speed up the growing time for a particular plant.	Discovery.
Time pressure ^b	Limited amount of time to complete an objective.	A player only has 15 minutes to complete a task.	Challenge.
Updated context ^b	Visual indicators of activities that pertain to the current context.	A status bar that indicates how much health one's character has left.	Sensation, narrative, fantasy.
Visibility / accountability ^b	Visibly demonstrating achievements or accomplishments in a game.	Leaderboard, badges, trophies.	Challenge, personal returns.

* In this column, "a" refers to Hunnicke et al. (2004), "b" to Robinson & Bellotti (2013), and "c" to Ruhi (2015).

After identifying a game-based IS's aesthetics and dynamics, designers need to select mechanics that support users' interactions in the system. If designers include the relationships dynamic, interaction modes is a mechanic that dictates how users can engage with one another in the system, such as "liking" another user's actions, chatting with other users, or sharing resources with other users.

Organizations can design mechanics specifically to serve as external or in-game rewards. For example, an organization may enter employees who complete a training program using a game-based IS into a lottery/draw/bet to receive an extra vacation day (i.e., an external reward). In contrast, the organization may offer an in-game reward, such as virtual currency/goods that allows a user to purchase virtual items to help the user complete a level more quickly. Other mechanics constitute in-game controls rather than rewards.

In-game controls serve as the foundation for gameplay and define how users interact with game elements and with each other in a game-based IS.

Using the game-based elements that Hunicke et al. (2004), Robinson and Bellotti (2013), and Ruhi (2015) identified, we identified game-based elements that concur with how the MDA framework defines mechanics. We define and provide examples of these dynamic game-based elements in Table 3. We group mechanics based on reward type (external and internal) and controls. We also identify dynamics that each mechanic game-based element may support.

Table 3. Game-based Elements Identified as Mechanics

Game-based element ^a	Definition	Example of implemented game-based element	Supported dynamics
External rewards			
Deals/discounts ^b	Deals and discounts that game makers offer to encourage engagement with their games.	Loyalty programs or special promotions.	Chance, consequences
Financial ^b	Financial rewards that game makers offer players for playing their games.	Cash prizes or vouchers.	Difficulty, chance, consequences
Goods/services ^b	Physical goods that game makers provide to promote their games.	Tote bags or water bottles for those that play the game.	Chance, consequences
Lottery/draw/bet ^b	Means to obtain extrinsic rewards from game makers through chance as opposed to earning rewards through gameplay.	Raffle entry to win rewards.	Chance
In-game rewards			
Scarcity of resources ^{a,b}	Limiting the resources, players' ability, or objects in a game to add interest, skill, or challenge.	A sword that drops randomly when one defeats a difficult enemy.	Time pressure, available game accomplishments, difficulty, chance, consequences, constraints, time, time pressure
Add to record of achievements ^b	Additional achievements based on specific events	A character title that a player receives after completing the winter holiday special in-game event.	Time constrained event, records for total game achievement, completion status, records of achievements, visibility/accountability
Validation ^b	Ability to obtain approval (or likes or kudos) from others in a game for activities in it.	Being awarded the one player commendation at the end of a group task.	completion status, leave a mark, visibility / accountability
Virtual abilities ^b	Ability to increase one's powers or skills in a game as one progresses through it.	Increased magic power at each new character level.	Available game accomplishments, difficulty
Virtual currency/goods ^b	Money or loot obtained in a game or that its maker providers.	Gold that players can obtain in a game and use to buy items such as weapons and gear.	Available game accomplishments
In-game controls			
Bonuses or penalties ^{a,b}	Adding new characters, expanding worlds, and including new abilities or skills to keep the game novel and interesting.	Adding a new area on the map with cities, enemies, and quests to explore.	Opponent play, available game accomplishments, difficulty, consequences, constraints, updated context

Table 3. Game-based Elements Identified as Mechanics

Interaction modes ^b	Forms of communication and interaction mechanisms that the system supports.	Trading/buying/selling goods, sharing gifts, commending other players by voting, collaborative efforts in a team (such as healing or reviving other players), and rivalries against other players.	Ambiguity to reach objective, opponent play, relationships,
Audio signals ^b	Auditory cues that complement a game or provide more information about the ongoing activities in it.	Enemies might have louder footsteps when closer to a user or music may imply imminent victory or defeat.	Completion status, difficulty, consequences, constraints, time, time pressure
Choice architecture ^{b,c}	Incorporating multiple game-based elements to enable players to make progress throughout a game.	Leaderboards, badges, and progress bars	Performance comparison, available game accomplishments, difficulty,
Courses of action ^c	Quests, levels, groups, and so on in the game that lead the players through the content as they complete them.	A player must complete ten levels to move from data entry clerk rank to help desk rank.	Performance comparison, available game accomplishments, difficulty, leave a mark, constraints, updated context
Graphical indicators ^b	Game cues that support a user's action or to alert the user to a failure.	Visual cues to alert users that their actions caused damage to an enemy, an objective has been met, or their character received damage from an enemy.	Ambiguity to reach objective
Guidance ^b	Tutorials, instructions, or explanations to help players become accustomed to gameplay and identify the objectives that they need to complete.	Text on the screen that a computer-generated player speaks and that provides instructions about how to complete a task.	Ambiguity to reach objective, game lore
Perceptual aspects ^b	Sensory-based cues or game aspects to add to the degree of immersion in the experience.	Control vibration, visual elements, and auditory cues.	Consequences, chance, difficulty
Specific rules ^{b,c}	Requirements for accomplishing objectives	Turns, prohibited actions, penalties, or randomness introduced to create unpredictability in the game.	Ambiguity to reach objective, relationships, renewal/regeneration, time, time pressure
* In this column, "a" refers to Hunnicke et al. (2004), "b" to Robinson & Bellotti (2013), and "c" to Ruhi (2015).			

The GSDF provides terminology and structure for designing game-based IS. Designers can use the GSDF to select combinations of game-based elements congruent with the desired "feel" or emotions for users based on how they understand their organization's needs and users' motivations. Unlike other frameworks for designing game-based IS, the GSDF encourages designers to begin by focusing first on aesthetics, dynamics, and then mechanics (unlike Ruhi, 2015) and determining what represents meaningful engagement when beginning the design process as opposed to considering it as an outcome of the process (unlike Liu et al., 2017).

4 Applying the Game-based System Design Framework

Information system designers frequently use formal modeling languages and tools to visualize and communicate data flows, database design, and requirements. For example, many systems analysts or designers use Unified Modeling Language (UML) diagrams to document and diagram processes, data, user stories, and sequencing. However, existing modeling approaches fail to address the game-based design elements in game-based IS. Furthermore, other modeling languages do not provide a mechanism to specify an information system's motivational components. Therefore, we created a standardized modeling language to support designers in visualizing and communicating a game-based IS's design when using the GSDF.

We developed the game-based system design diagram (GSDD) to help designers in designing game-based IS.

The GSDD incorporates five symbols and two types of arrows (see Figure 1). The first symbol, the organizational problem, describes the organization's problem that creates a need for a game-based IS. The second symbol, usage objectives, describes users' motives (Blohm & Leimeister, 2013) for engaging with the game-based IS. The third symbol, aesthetics, draws on the game-based elements from Table 2. The fourth symbol, dynamics, draws on the game-based elements from Table 3. Finally, the fifth symbol, mechanics, draws on the game-based elements from Table 4. Finally, the diagramming method uses two arrows: a single-headed arrow and a double-headed arrow.

Designers can develop the GSDD when initially using the GSDF to design a game-based IS. Designers who wish to refine or improve on an existing GSDF may use the GSDD to document the system's elements and examine how well an organizational problem, usage objectives, aesthetics, dynamics, and mechanics align in the game-based IS.

Figure 1. Game-based System Design Diagram

4.1 Organizational Problem

Assume an organization seeks to create a new game-based IS to improve its employee training outcomes. In this scenario, the organization struggles with ensuring employees sufficiently engage with training programs that they need to complete to comply with industry and/or governmental regulations. To apply the GSDF in this scenario, designers would first need to identify and state the organizational problem. They should state this organizational problem as concisely as possible in the GSDD while still communicating the primary reason for which the organization develops the game-based IS (i.e., “engage employees in required organizational training”).

4.2 Usage Objective

Next, designers and other stakeholders in the organization should consider the usage objective. In our scenario, users engage with the game-based information system to meet organizational standards and requirements for training purposes. Designers would need to understand users' motives in order to select the aesthetics for the game-based IS. In creating the GSDD, they should identify and document the usage objective(s) (i.e., “meet organizational standards”).

4.3 Aesthetics

Next, designers would refer to the aesthetics table in the GSDF (i.e., Table 1) to review the game-based elements that support aesthetics. They would need to identify which aesthetics would most appropriately support both the organizational problem and usage objective. When selecting aesthetics, they would need to consider if aesthetics that support intrinsic motivation, extrinsic motivation, or both would best support the usage objective. This careful choice about the game-based IS's "feel" helps to ensure an alignment between the organization problem and usage objective (as the connection from the user objective and organizational problem to the aesthetic in the GSDD in Figure 1 indicates).

4.4 Dynamics

Once designers determined the aesthetic, they would need to review the dynamics table in the GSDF (i.e., Table 2) to identify which dynamics to incorporate into the system. They can locate the selected aesthetic(s) in the "supported aesthetics" column in Table 2. They would need to consider which dynamics to include to support the game-based IS's intended aesthetics and user motivation.

4.5 Mechanics

After identifying the appropriate dynamics, designers would need to select which mechanics to incorporate in the game-based IS. They can reference the mechanics table in the GSDF (i.e., Table 3) and refer to the "supported dynamics" column to identify relevant mechanics. They would then need to consider how to fully implement the chosen mechanics and dynamics to support the desired aesthetic. In Table 4, we summarize the process designers can use to apply the GSDF and GSDD in creating a new game-based IS.

Table 4. Applying the GSDF and GSDD for a New Game-based Information System

Step	Direction	Employee-training example
1	Identify the organizational problem	Engage employees in required organizational trainings
2	Identify the usage objective	Meet organization standards
3	Select aesthetics (Table 1) that align with the user motivation and organization's problem (indicate if E, I, or E/I)	Select compliance (E) and commendation (E) as aesthetics for the game-based information system
4	Select dynamics (Table 2) to help develop the aesthetics selected in the third step	Select relevant dynamics based on the chosen aesthetics "compliance: ambiguity to reach objective" and "opponent play commendation: completion status"
5	Select mechanics (Table 3) that help develop the dynamics selected in the fourth step	Select relevant mechanics based on the chosen dynamics "ambiguity to reach objective: graphical indicators, specific rules", "opponent play: bonuses or penalties, interaction modes", and "completion status: add to record of achievement, validation".

In Figure 2, we show the GSDD for this employee-training example. By using the GSDD modeling method, one can create a deliverable for designing and planning a game-based IS development project. The resulting diagram serves as a communication tool among stakeholders. The GSDD ensures that all single-headed arrows converge on the design's aesthetics. We designed the GSDD to intentionally do so since it communicates users' emphasis on emotions and experiences.

The GSDD structure adheres to the rules that we explicate in Table 5. The diagram structures in the "incorrect" column show arrow types and directions that do not support design flows that focus on aesthetics and an alignment between a game-based IS and organizational problem. The structures in the "correct" column demonstrate how to create the aesthetically focused GSDD. The "rule description" column explains each correct structure. Rules in *italics* constitute additional rules that help designers notate information in the GSDD.

Figure 2. Example GSDD for Employee-training Game-based Information System

Table 5. Rules for Developing a Game-based System Design Diagram

Rule	Incorrect	Correct	Rule description
1			A) Double-headed arrow needs to connect the organizational problem with usage objectives to indicate alignment
2			<p>B) A single-headed arrow needs to originate from alignment line between organizational problem and usage objective that points to each aesthetic</p> <p>C) Multiple aesthetics may connect to the alignment line between the organizational problem and usage objective</p> <p>D) Aesthetic requires a number convention of A# followed by /E, /I, or /EI</p>

Table 5. Rules for Developing a Game-based System Design Diagram

3			<p>E) Single-headed arrow required from dynamic to aesthetic to indicate the dynamic supports the creation of the aesthetic.</p> <p>F) Multiple dynamics may connect to a single aesthetic</p> <p>G) A single dynamic may connect to multiple aesthetics</p> <p>H) Dynamics requires a number convention of $D\#$</p>
4			<p>I) Single-headed arrow required from mechanic to dynamic to indicate the mechanic supports the creation of the dynamic.</p> <p>J) Multiple mechanics may connect to a single dynamic</p> <p>K) A single mechanic may connect to multiple dynamics.</p> <p>L) Mechanics requires a number convention of $M\#$</p>
<p>* We based the pattern for the structure of the table off Hoffer, George, and Valacich's (2014) work in which they provide guidance for creating data flow diagrams.</p>			

Designers would use the GSDD in conjunction with data flow diagrams (DFDs) and entity-relationship diagrams (ERDs) to design and develop game-based IS. Given that a game-based information system still

constitutes an information system, DFDs and ERDs remain useful; however, the GSDD provides a design tool that pertains specifically to the game-based IS environment to ensure that the aesthetics, dynamics, and mechanics align with an organization's problem and users' motives.

In the Appendix, we further explain how to apply the GSDF and GSDD by referring to two game-based IS that two organizations developed for the same purpose: to expand the talent pool for recruiting applicants to their organization. We describe these systems' purpose and demonstrate how to apply the GSDF and GSDD to identify opportunities to strengthen and improve existing game-based IS.

5 Discussion

The GSDF emphasizes the need to design a game-based IS that addresses an organization's problem in a manner consistent with users' motives. To help designers achieve this objective, the GSDF encourages them to first focus on the system's aesthetics or emotional components (consistent with Mullins & Sabherwal, 2020). Furthermore, the GSDF helps designers design game-based IS by explaining how various game-based elements support specific aesthetics, dynamics, and mechanics. By applying the GSDF and visualizing the results through the GSDD, designers can ensure that the game-based elements that they embed in a game-based IS align with an organization's needs and users' motivation.

Researchers developed the MDA framework to support communication among stakeholders in the game-design process (Hunicke et al., 2004). Since its development, multiple game-based information system frameworks have used MDA in full or in part (e.g., Bui, Veit, & Webster, 2015; Ruhi, 2015; Suh & Wagner, 2017). In this research, we view the MDA through the MDE lens because it views aesthetics as emotions—mental states and reactions to a gaming experience (Mullins & Sabherwal, 2020; Robson et al., 2015). Typically, game-based IS designers focus on choosing mechanics first and emotions last. Players, on the other hand, experience their interaction with the gamified system through emotions. Mullins and Sabherwal (2020) posit that “game emotions should align with the desired emotional outcome” (p. 309). We extend this position to include the alignment between the emotional outcome and an organization's need. One meaningful difference regarding the GSDF as compared to other game-based information system design frameworks concerns its focus on aesthetics when selecting game-based elements. By considering MDA in the reverse order with aesthetics first, the relationships among aesthetics, dynamics, and mechanics gain clarity. It becomes possible to identify how choices related to aesthetic elements could influence dynamics, which, in turn, affects the mechanics designers choose in a game-based IS. Although the GSDF follows a different process than other game-based IS design frameworks, our approach has consistencies with the game-based IS design principles that other frameworks have identified (e.g., Liu et al., 2017).

Furthermore, other game-based IS frameworks redefine one or more terms from MDA due to concerns with how researchers originally conceptualized mechanics, dynamics, and aesthetics (Bui et al., 2015; Robson et al., 2015). Unfortunately, researchers have altered or adapted the way they have defined or applied mechanics, dynamics, and aesthetics across contexts, which has created confusion regarding MDA's terminology. Some game-based IS design frameworks do not explicate various game-based elements as mechanics, dynamics, or aesthetics (Liu et al., 2017; Suh, Wagner, & Liu, 2015). The lack of consistency in the terminology and literature related to MDA has resulted in researchers criticizing the MDA for insufficient conceptual clarity (Liu et al., 2017). Therefore, the GSDF uses the MDA's original definitions that Hunicke et al. (2004) provided and leverages MDA with its original intent (i.e., a communication tool). In developing the GSDF, we realized that some confusion related to MDA terminology could be due to the range of stakeholders involved in designing a game-based IS. System designers may prefer to begin discussing mechanics or dynamics, while users may prefer to begin considering aesthetics and feel.

Many game-based IS design frameworks consider motivation, often in the self-determination theory context (Ryan & Deci, 2000a, 2000b). Some frameworks primarily focus on desire to promote intrinsic motivation (e.g., Suh et al., 2015). Other gamification frameworks may discuss intrinsic or extrinsic motivation but fail to clearly identify how game-based elements can support intrinsic or extrinsic motivation (Liu et al. 2017; Bui et al., 2015; Ruhi, 2015). MDA has no preconceived notions regarding the role and use of intrinsic or extrinsic motivation in designing game-based IS. The GSDF encourages designers to specifically consider how a game-based IS's aesthetics support users' intrinsic and extrinsic motivations. Designers need to select and implement subsequent dynamics and mechanics to ensure they align with users' motivations. Formal design mechanisms for information systems review data's structure, its flow, and the stories about what users want to do in or with the system. However, we currently lack a formal design mechanism for considering aesthetics in game-based IS. The GSDF and GSDD fill this role.

The GSDF also has much flexibility to evolve as designers create or implement new game-based elements in new and creative ways. In Tables 1 to 3, we classify game-based elements from multiple frameworks as aesthetics, dynamics, and mechanics using definitions from the MDA. We also identify which dynamics game-based elements can support specific aesthetics and which mechanics can support various dynamics. We list supported aesthetics (see Table 2) and dynamics (see Table 3) based on our experience with game-based IS; however, others can expand these lists as they use game-based elements in novel and creative ways. The GSDF and GSDD provide an overarching framework that helps designers rethink how they design game-based IS and encourages them to focus on the system's aesthetics first based on an organization's problem users' motivation.

5.1 Implications for Practice

As Figure 1 shows, designers need clear communication regarding the organization's problem, users' motives or objectives for engaging with the system, and the intended emotions (i.e., aesthetics) early in the game-based IS design process.

Using GSDF and GSDD can help designers determine requirements and document system designs for new game-based IS. Also note that organizations that need to improve or enhance an existing game-based IS can use the GSDF and GSDD as an evaluation tool. By identifying and mapping existing game-based elements to the GSDF (and resulting GSDD), stakeholders can identify gaps, weaknesses, and limitations to develop a plan for addressing concerns.

Similar to how DFDs and ERDs enable communication among stakeholders in the design and development process for information systems, the GSDF and GSDD constitute useful tools to help stakeholders in designing and developing game-based IS. Our framework reveals the need to ensure that the different game-based elements work together to support the overarching goals for a system. Failure to consider the alignment between an organization's problem, users' motivations, and the game-based elements used for aesthetics, dynamics, and mechanics can lead to a system that fails to meet its objectives.

5.2 Implications for Research

Recent studies in gamification have identified gaps in the existing literature and called for more nuanced research regarding game-based IS. Authors have called for researchers to pay more attention to the "contextual factors affecting the gamification as potential source for varying results" (Majuri, Koivisto, & Hamari, 2018, pp. 17-18). Other scholars have expressed a "need of research on gamification with strong theoretical links that bridge the gap between theory and practice" (Alsawaier, 2018, p. 60). In this study, we integrate theory and practical game-based approaches and provide a foundation for further research.

First, we encourage researchers to explicitly consider the role that aesthetic game-based elements play in supporting intrinsic and/or extrinsic motivations for game-based IS users. We continue the conversation on the importance of considering and studying both game-based elements that support extrinsic motivation alongside elements that support intrinsic motivation, which game-based IS research does not always examine (Alexiou & Schippers, 2018; Buckley et al., 2018; Suh, Cheung, Ahuja, & Wagner, 2015). Researchers should not assume that game-based IS users are automatically extrinsically motivated to use the system because the IS includes elements of play. Since extrinsic motivators can either crowd out (Bui et al., 2015; Ryan & Deci, 2000a, 2000b) or transform into intrinsic motivators (Jacobs, 2013; Muntean, 2011), scholars should examine the role and value of extrinsic and intrinsic motivators in game-based IS.

For research evaluating the development, design, or success of game-based IS, the GSDF and GSDD offers a means to do for new and existing game-based IS using an aesthetic focus. This approach concurs with recent calls for increased focus on the design and designers' intentions in creating game-based IS (e.g., Lowry et al., 2020; Khan et al., 2020). The framework and diagram provide a means to ensure congruence among the various game-based elements in a system. The GSDF and GSDD can help researchers identify a lack of synergy among various game-based elements that may prevent users from adopting a game-based IS. The GSDD constitutes a proof-of-concept diagram that could benefit from proof-of-value testing in an organizational setting.

Empirical research on game-based IS often focuses on select game-based elements to determine how elements affect users' motivations, their perceptions about a system, their intentions to engage with the system, or their system use (Suh et al., 2015). The extant literature contains many surveys and studies that examine outcomes from implementing game-based elements (Alsawaier, 2018). However, we could more

deeply understand game-based IS users' motives by engaging in discourse with stakeholders at all levels of game-based IS. The GSDF identifies how specific game-based elements (e.g., challenge as an aesthetic) relate to other game-based elements (e.g., performance comparisons, available game accomplishments, difficulty, opponent play, chance, among others in dynamics) and emphasizes the need to consider game-based elements in the context of an organization's problem and users' motivations. Empirical research that examines a specific game-based element's effectiveness may find that the element promotes beneficial outcomes in some circumstances but not in others. Research on game-based elements should consider not only the elements and the outcomes but also how well the elements align with the organizational problem, organizational context, users' motivations, and other game-based elements that the system deploys. The GSDF offers researchers the ability to consider the impact that game-based elements have on game-based IS outcomes in a more nuanced way. Future research should aim focus on more deeply understanding the organizational game-based information system phenomenon rather than on broadening it.

Game-based IS research (and its other streams, such as gamification and serious games) constitutes a behavioral science in that, once applied, game-based IS techniques change the state of the individuals who interact with the phenomenon (Landers, Auer, Collmus, & Armstrong, 2018). As such, research on game-based IS must be iterative in that researchers should study a system's effectiveness in conjunction with the state of the individuals who engage with it (Khan et al., 2020). Further game-based IS research could incorporate the idea of scientist-practitioners seeking to understand both game-based IS and their effects on stakeholders at all levels.

5.3 Limitations and Future Research

As with any study, ours has some limitations. In particular, we considered only intrinsic and extrinsic motivations in SDT. We did not include organismic integration theory (OIT) elements or SDT subtheories in discussing motivation (Deci & Ryan, 1985). By considering only intrinsic and extrinsic motivation for game-based IS, we created a more simplified framework. Thus, in future research researchers should explore how to incorporate and implement differing aspects of intrinsic and extrinsic motivations within specific game-based design elements. Additional research may also use SDT more fully to examine how motivations may change by introducing specific design elements in a game-based IS.

In the appendix, we demonstrate how to apply the framework hypothetically for two existing, externally facing game-based IS for human resources. The approach that we describe in the Appendix for applying the GSDF and GSDD would be similar for both internal and external systems. While organizations may want to use external game-based IS to keep people engaged for longer periods of time, internal systems may encourage users to complete their tasks and move on to other tasks (e.g., training). Yet, the GSDF and GSDD contain enough flexibility to accommodate various game-based IS and contexts, which future research could explore.

6 Conclusion

In this study, we increase our knowledge about designing game-based IS by creating the game-based system design framework. This framework enables designers to select appropriate game-based elements that support a game-based IS's aesthetics, dynamics and mechanics and ensure that the aesthetics, dynamics, and mechanics align with an organizational problem and usage objectives. Second, we demonstrate how to visualize a game-based IS's design using the game-based system design diagram. The design diagram provides a useful means to explain the way in which game-based elements interconnect.

Game-based IS offer organizations an opportunity to engage users in interesting and meaningful ways that align with an organizational problem and usage objectives. Researchers have recognized efforts to merely add game-based elements to new or existing systems to introduce play as an ineffective method to achieve desired outcomes with gamification or other forms of game-based IS (Ferrara, 2012; Zichermann & Cunningham, 2011; Deterding, 2014). Game-based IS can be complicated and challenging to implement because each one can result in a different outcome (Ruhi, 2015). However, through a careful, systematic design process to consider which game-based elements support an organization and users, designers have the potential to demystify efforts to develop game-based IS. The game-based system design framework and game-based system design diagram offer stakeholders a method to thoughtfully consider whether game-based IS's design aligns with an organizational problem and usage objectives.

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Appendix: Applying the Gamified System Design Framework for Employee Recruitment

Organizations often refer to the challenges they face in identifying and recruiting employees with the necessary skills that their open positions need as the “war for talent” (Michaels, Handfield-Jones, & Axelrod, 2001; PwC, 2018). Many organizations leverage gamification to expand their applicant pool (Bina, Mullins, & Petter, 2021). We evaluate two information systems that incorporate game-based approaches for recruiting employees by applying the gamified system design framework (GSDF) and gamified system design diagram (GSDD).

As a volunteer-based military, the United States of America must recruit citizens into its armed forces. In the late 1990s, the U.S. Army struggled to recruit individuals to enlist (White, 2005). To counteract misinformation about the military, an officer spearheaded a project to provide a different perspective to potential recruits. The U.S. Army launched a game called America’s Army in 2002. As the player successfully completes missions in the game and abides by the U.S. Army’s core values, the player earns “honor points”. To progress through the ranks, players must abide by the U.S. Army’s core values and tenets (Leo, 2017). The game enables individuals to explore specialized careers and training such as Airborne, medical, and marksmanship training.

The U.S. Army used America’s Army as a means to enable adolescents and young adults to learn more about the career opportunities and experience of serving in the U.S. Army (White, 2005). As a game, America’s Army has been successful based on the number of downloads and critical acclaim. By 2005 (three years after the game’s initial release), about 40 percent of individuals who enlisted in military service said that they had played America’s Army (Katwala, 2020).

Marriott International also needed a creative way to recruit individuals for more than 50,000 positions internationally in its hotel group. In a corporate blog, Marriott International explained: “In some countries, parents want their children to be doctors and lawyers, and discourage them from pursuing careers in hospitality. But we want them to know that hotel careers can be very rewarding” (Marriott, 2011). The organization launched a Facebook game called “My Marriott Hotel” in 2011. In the game, users work in a hotel kitchen and must ensure food items meet quality standards, purchase inventory, manage budgets, and hire staff. The company planned the kitchen game as the first in a series to help individuals learn about the various careers and opportunities available at Marriott International (Shoppers Shop, 2011).

The company made the game available on Facebook in multiple languages (English, Spanish, French, Arabic, and Mandarin) and targeted Millennials. By launching the game on Facebook, Marriott International sought to embrace recruiting’s social component. My Marriott Hotel received significant media attention for using social media and gaming to recruit applicants. Many compared My Marriott Hotel’s game design to other popular games and apps in 2011, such as Farmville or The Sims. In the first two weeks of launch, people in 83 countries played My Marriott Hotel (Marriott, 2011). However, a year after it launched, some referred to My Marriott Hotel as a failure in gamification (Kleinberg, 2012) given that Marriott International did not release additional modules. Subsequently, the company removed the game from Facebook. Many criticized the game for only appealing to a narrow audience and being a poor source of entertainment. Others criticized My Marriott Hotel because users could not connect their gameplay to the careers and activities relevant for most applicants to Marriott International.

Organizational Problem

Both America’s Army and My Marriott Hotel constitute game-based information systems that the companies designed to recruit potential employees. Each organization experienced difficulties recruiting entry-level employees and had a similar organizational problem: a need for individuals to gain new perspectives about career opportunities in their organization. The U.S. Army realized many potential recruits did not fully understand career opportunities or entry-level requirements for the military. Marriott International realized many individuals failed to understand the potential for growth and opportunities in the hospitality field and in the organization itself.

Usage Objectives

In both scenarios, the organizations used a game-based information system as a persuasive technology to encourage users to reconsider their opinions about career opportunities in each organization. Designers

must consider potential users' motives for engaging with the game-based IS (Blohm & Leimeister, 2013). Both organizations wanted to stimulate a sense of identification in which prospective military recruits or hospitality industry employees would envision themselves in the type of role that their game-based IS presented. The U.S. Army and Marriott International wanted to create a sense of awareness about entry points and career opportunities in each organization among users as a means to encourage them to consider careers in them.

Aesthetics

America's Army and My Marriott Hotel incorporated multiple aesthetic elements in their game-based information systems. To demonstrate how to use the GSDF, we focus on a single aesthetic element consistent across both game-based IS: cognizance. The cognizance game-based element enables users to understand the organizational environment, which promotes intrinsic motivations in them (Ruhi, 2015). Cognizance constitutes an aesthetic that provides both intrinsic and extrinsic motivation as users engage with a game-based IS to gain more insight and knowledge about an organization or context.

Dynamics

After identifying specific aesthetic elements to support the organizational problem and usage objectives, designers should determine which dynamic game elements support the chosen aesthetics (using Table 3). Four game-based elements apply to cognizance. Designers may not use all four elements as dynamics in an information system; however, each of the four game-based elements can promote cognizance, the desired aesthetic. Designers should carefully consider how to incorporate one or more of these dynamics to support this aesthetic. Table A1 summarizes how the U.S. Army and Marriott International implemented each element in their game-based information systems.

Table A1. Selected Dynamics of America's Army and My Marriott Hotel

Game-based element	Incorporated in America's Army	Incorporated in My Marriott Hotel
Ambiguity to reach objective	Yes: objectives (and their associated tasks) have varying complexities of objectives consistent with missions and roles in the U.S. Army.	Limited: objectives have some similarity with kitchen roles in a hotel, but many tasks are clearly defined and performed according to the routine that is determined and specified for the play.
Available game accomplishments	Yes: multiple paths to pursue accomplishments in the game consistent with career progression in the U.S. Army. Users can pursue specialized training (e.g., medic training, Airborne training, etc.) based on personal goals.	Limited: the game has some accomplishment, but they are static in that all users progress in the same way. Progress inconsistent to career progression in the organization.
Opponent play	Yes: play against or with simulated or other players based on the game mode.	No: users do not engage with others or play against others during the game.
Consequences	Yes: users gain or lose honor points based on their actions and behaviors, which affects gameplay. Players receive honor points for actions consistent with the U.S. Army's values.	Yes: users must perform adequately to progress to other levels. Performance has some relation to career progression requirements at Marriott International, such as maintaining quality standards and meeting budgetary requirements.

The U.S. Army implemented each dynamic, while Marriott International did so to a more limited degree. America's Army and My Marriott Hotel strongly differed in the dynamics their designers chose and implemented. The designers who designed America's Army accurately simulated and demonstrated organizational process elements for recruiting, rewards, opportunities, and promotions in the U.S. Army. In America's Army, players start at the bottom and work their way up the career progression in the U.S. Army much like the typical enlisted service member. In contrast, in My Marriott Hotel, each user begins gameplay as a hotel manager, which does not represent the typical entry point for most employees at Marriott International. Furthermore, My Marriott Hotel did not create dynamics consistent with Marriott International's process for career progression or its organizational culture. As a result, the way in which Marriott International implemented the dynamics for the game failed to create a strong connection to the cognizance aesthetic for players.

Mechanics

After identifying dynamics, designers can determine which game-based elements best support the mechanics in a game. Table A2 lists some mechanics relevant to the dynamics that America's Army and/or My Marriott Hotel used.

Table A2. Selected Mechanics of America's Army and My Marriott Hotel

Game-based element	Incorporated in America's Army	Incorporated in My Marriott Hotel
Scarcity of resources	Yes: limited life/health ability, limited abilities or skills developed over time.	Yes: time and budget limitations in the game to mimic time pressure in the role.
Virtual abilities	Yes: players gain additional skills and knowledge in the game based on successfully completing objectives.	Yes: levels progress with increasing difficulty with different responsibilities for managing a hotel kitchen.
Virtual currency/goods	No: the game does not include currency because it lacks consistency with the overall goals for the game-based IS.	No: currency lacks relevance given the goals for the game-based IS.
Bonuses or penalties	Yes: new weapons, skills, ranks available as players progress through the game.	Yes: levels increase in tasks and difficulty through game progression similar to increasing responsibility in hotel management.
Interaction modes	Yes: players must work with other users or computer-generated players to accomplish objectives in the game.	No: no opportunity to interact with others in the game.
Choice architecture	Yes: players can evaluate themselves and gain ranks and credentials throughout the game similar to career progression in the U.S. Army.	Limited: progress bars within levels but no leaderboards, badges, or other comparison elements. Progress in the game does not resemble real career progression.
Courses of action	Yes: players complete different types of objectives and trainings similar to the choices available in the U.S. Army.	No: original game had only one career path (e.g., kitchen manager) with plans for different games with other career paths; plans for game-based information systems with additional career paths abandoned.
Guidance	Yes: players begin as a new recruit, so they receive instructions and tutorials as needed when their skills progress.	Yes: first level is a tutorial to guide new players through gameplay.
Perceptual aspects	Yes: immersive experience to simulate combat or other elements of the U.S. Army.	Weak: visual cues of a hotel kitchen but cartoonlike; does not adequately represent a true hotel kitchen.
Specific rules	Yes: the game includes tasks and qualification that have specific requirements for completion.	Yes: incorporated in tasks in each level.

When implementing mechanics, designers should ensure that they support both the selected dynamics and the original cognizance aesthetic. In supporting the cognizance aesthetic, which supports intrinsic and extrinsic motivation, America's Army included interaction modes (which supports two dynamics, ambiguity to reach objective and opponent play) that allow individuals to collaborate with others to achieve a goal similar to the experiences a real soldier encounters in the U.S. Army. In My Marriott Hotel, users engage as a hotel manager, but they have no opportunity to interact with other players, which differs from the experience an individual would have if working at Marriott International. In applying the GSDF, designers need to ensure that dynamics and mechanics align in a way that supports a game-based IS's overarching aesthetics.

Game-based System Design Diagram

By creating a GSDD for each game-based IS, we can visually identify differences between America's Army and My Marriott Hotel. Figure A1 demonstrates the strong flow and alignment among the organization problem (organizational recruiting), the usage objectives (identification, awareness), and the aesthetic (cognizance) and the implemented dynamics and mechanics in America's Army. This diagram is incomplete in that we only diagram a single aesthetic (i.e., cognizance); however, we can use the diagram to

demonstrate how designers can leverage multiple dynamics to support a single aesthetic and a single mechanic can support multiple dynamics.

Figure A1. Game-based System Design Diagram: America's Army

In contrast, Figure A2 shows My Marriott Hotel's game-based design for the cognizance aesthetic. In only applying certain dynamics to a limited degree, the organization restricted the ability for the selected mechanics to support the cognizance aesthetic. Designers must carefully identify which dynamics and mechanics they should include in a system to support the intended aesthetic and make deliberate choices about how to implement the dynamics and mechanics. Different choices in implementing dynamics and mechanics game-based elements can affect user motivation's sources, which can create an incongruence with the intended aesthetic.

Figure A2. Game-based System Design Diagram: My Marriott Hotel

We applied the GSDF and GSDD only to a single aesthetic incorporated in the game-based information systems that the U.S. Army and Marriott International designed. Therefore, the illustrations do not exhaustively cover all aesthetics, dynamics, and mechanics for each system. However, this appendix demonstrates how designers can apply the GSDF and GSDD 1) when designing a game-based IS to identify elements to include in it or 2) after creating a game-based IS to identify opportunities to improve its design to ensure its consistency with an organizations problem; usage objectives; and the aesthetics, dynamics, and mechanic game-based elements in the system.

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