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Abstract:

The use of gamification for organizational initiatives, like increased foot traffic and customer engagement, is on the rise. As such, recent information systems graduates may find themselves on project teams aimed at making decisions about gamification efforts. Currently, information systems curriculum doesn't typically address the use of specific frameworks to design and document requirements for a game-based information system to meet a business need. This teaching case exposes students to the use of the Game-based System Design Framework in combination with the Game-based System Design Diagram to enhance student learning around the design and documentation of a gamified information system. This case could be used in an undergraduate or graduate program in either a systems analysis and design or a capstone course. Use of this case assumes that students have a basic understanding of business requirements gathering and project scope statements. Additionally, in order to develop a solution to this case, it must be used in conjunction with the article "All Work and All Play? A Framework to Design Game-based Information Systems" (Barber et al., 2021).

Keywords: Gamified Information Systems, Teaching Case, Systems Analysis & Design, Gamification.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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1 Introduction

Congratulations! You have been hired as the new Information Systems Business Analyst at Scout County Public Library. In this new role, you are assigned to a team of employees who are attempting to innovate the summer reading program. The director of the library saw their grandchild playing a game for school on a smartphone and has begun to wonder if developing some sort of online game for the summer reading program would increase engagement. Your background in information system design will be useful for the project. You have a good understanding of how to create design documents for a traditional information system. But you've never designed a game before and are fairly certain you will need some guidance and structure to complete the project successfully. In preparation, you conducted some research into advances in the design of gamified information systems and located an article titled: All Work and All Play? A Framework to Design Game-based Information Systems (Barber et al., 2021) in which the authors present a Game-based System Design Framework that includes design diagrams that you believe will be helpful in designing the gamified summer reading program.

The director has requested that you focus on a design for children in kindergarten through sixth grade. Additionally, they created a list of expectations for this phase of the design project.

- Clearly define the business need for the project
- Identify how the users would engage with the system to meet the business need
- Generate design documents for passing through to a developer to build the game
- Create initial screen mockups/wireframes for the game

They would like the game to be operational for next summer's reading program. With that in mind, they have some additional design aspects for you to consider. These should be addressed in your final design documentation either as narrative responses or in the actual game design.

- This is only phase one of the project. Could future phases include expansion to (a) middle and high school students, and (b) adults? If so, how?
- Would it be possible to expand the game to be year-round and have seasonal events? The director has seen matching games their spouse plays on the smartphone have these types of incentives.
- Are there ways to use the game as a means to get more foot traffic in the library?
- Will the users be able to design their own players in the game? The library is supportive of diversity, equity, and inclusion and the director believes that allowing patrons to design their own player could increase a feeling of connection to the game and thus the library.
- Could there be a feature that allows local school teachers to create a recommended reading list inside of the game?
- Can the game be linked to a patron's library account? This would allow for tracking of books read to aid in collection management.
- Could there be special events for audiobook usage?
- Could the system generate frequency counts for books entered into the game as 'read' but which are not in the library collection? This could aid the collections librarian in identifying books that should be acquired.

In order to fulfill the expectations of the gamified summer reading program project you must first gain an understanding of the business of Scout County Public Library and the summer reading program. Then you will use the Game-based System Design Framework to create the Game-based System Design Diagrams for the Read to Win gamified summer reading program.

2 Scout County Public Library

2.1 The Business

Scout County Public Library is situated in the city of Manmeth, the heart of Scout County. It was founded in 1818 when Manmeth was incorporated. The city population is approximately 27,000 people but the

library also serves the surrounding rural locations. Collections within the library cover a broad range of topics and span all age groups. Currently, the library employs six librarians who oversee the children's section, the teen center, the reference section, acquisitions, special programs, and now you. Additionally, there are four circulation desk clerks. The library has approximately 31,000 children's books in print. Additionally, the library provides access to downloadable software that provides access to over 1,400 e-books for children in grades K-6.

The COVID pandemic changed the way patrons interact with the library, causing foot traffic and the use of library services to decrease. Now that the pandemic is over, the library would like a way to increase service use, as well as reading. The director is hoping that a gamified summer reading program will be the catalyst to improved connections with patrons with added benefits of assessing their collection, encouraging interaction with the library, and maybe even identifying new services they can provide.

2.2 Summer Reading Program

The summer reading program has been a service of the library since 1942. It has gone through many iterations over the years, partnering with local businesses to provide prizes and incentives for children who read targeted numbers of books each summer. The basic concept of the summer reading program is that children log the books that they read during the summer. When they log their books, they work toward the number of books read benchmarks set by the library. For each benchmark reached there is a prize with a grand prize being issued if the child meets all of the benchmarks.

The summer reading program begins June 1st of each year and ends August 15th. Children can begin logging their books and activities at the start of the program and continue to do so until the end of the day on the last day of the program. Prizes can be claimed until August 25th. Children can log the books they read in two ways: choosing from the list of books provided by the library (that are already in the library collection), or entering the basic information about a book not listed in the list provided by the library.

In addition to reading books, children can get activity points for reading specific books. For example, one activity might be to read a non-fiction book about history or a fairy tale. Activity points can also be earned by completing such things as reading to a family member, putting a puzzle together, or writing a poem.

Because the gamified version would be an electronic log, it could be possible to combine in-game prizes and incentives with face-to-face prizes and incentives. This may be dependent on the ages of the children as four-year-old children may not be as motivated by in-game incentives as perhaps a ten-year-old child would. These types of considerations should be discussed by the design team with decisions made and justified in the design documents.

3 Project Requirements

3.1 Business Need

The first expectation is for the team to understand and clearly articulate the business need of the project. The business need can be thought of in terms of the reasons, or justification for a project and can be developed through consideration of "the company's overall mission, objectives, and IT needs" (Tilley and Rosenblatt, 2017, p. 41). A thorough investigation for the development of the problem/opportunity statement should include "tangible and intangible economic benefits and costs and the technical and organizational feasibility of the proposed system" (Valacich and George, 2020, p. 111). As such, you have determined that the business need section of the documentation should be an abbreviated project scope statement that includes:

- Problem/opportunity statement
- Project objectives
- Business benefits (tangible and intangible)
- Business costs (tangible and intangible)
- Project deliverables
 - Game-based System Design Diagrams
 - Screen Mockups
 - Narrative answering questions presented in the introduction

3.2 Anticipated User Engagement

Anticipated user engagement requires the identification of facts about the users of the system. In standard systems analysis and design, there are five questions asked about users “who, what, where, when, and how” (Tilley and Rosenblatt, 2017, p. 119). Traditionally, the analyst has to understand how the processes are currently being completed and by whom. So, you believe the questions in Table 1 should be answered.

Table 1. Fact-Finding Questions

Current system	Game-based system
Who participates in the summer reading program?	Who will play the summer reading game?
What do participants do during the summer reading program?	What will players do in the summer reading game?
Where do participants track their summer reading program progress?	Where will users play the summer reading game?
When do participants participate in the summer reading program?	When will users play the summer reading game?
How do participants participate in the summer reading program?	How will users play the summer reading game?

There are two aspects of this stage of documentation that must be understood:

1. What is done in the system currently may not be exactly what will be done in the new system. This is okay. Unnecessary steps may be excluded and new, necessary steps, may be added.
2. The ‘what’ and ‘how’, while they seem similar, are very different aspects of the system. The ‘what’ are the processes that will be completed in the system. The ‘how’ is the way those processes will be completed.

3.3 Game-based System Design Framework

3.3.1 The Framework

Although an online game is, at its foundation, an information system, the aspects that make it ‘gamified’ go beyond understanding the users, data, and process flows as are typical design pieces of an information system. As you have identified, one way to understand these additional aspects is through the application of the Game-based System Design Framework (Barber et al., 2021) which was developed from previously existing game design information and frameworks (Hunicke et al., 2004; Robinson & Bellotti, 2013; Ruhi, 2015). Your desire to be a meaningful member of the design team for this gamified summer reading program promotes your goal of ensuring that the design is aligned with the business problem/need for the project. The Game-based System Design Framework (GSDF) includes this alignment as the first consideration in the design process as shown in Figure 1.

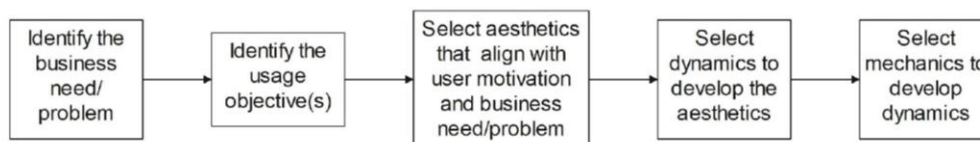


Figure 1. Game-based System Design Process

Although the business problem/need has broadly been articulated by the director, your team must narrow your understanding to a single statement. Barber et al. (2021) note that the *business problem/need* statement should communicate “the primary reason for which the organization develops the game-based IS”. Once that statement has been developed you and the team must identify why patrons would use the gamified summer reading program system. What would motivate them to use it? Those motivations become a list of *usage objectives* which will then be plugged into the Game-based System Design Diagram and against which aesthetics are chosen. To finalize the usage objectives, you must consider why the users would play the game.

As you understand it, the framework includes three aspects of game design: mechanics, dynamics, and aesthetics which align with each other toward the goal of a high-level alignment between the gamified system and business objective/need. Definitions and examples of each of the aspects are taken from

Barber et al. (2021) and outlined in Table 2. It is the aesthetics that are chosen first as they are most closely related to an individual's motivations to use the gamified system.

Table 2. Game Design Aspects

Game Aspect	Definition	Examples
Mechanic	Rewards and controls that determine how players interact with the game	Scarcity of resources, virtual goods, bonuses or penalties
Dynamic	How players interact with the game and the game responds to player action	Difficulty, chance, time pressure
Aesthetic	Game components that can evoke a player's extrinsic or intrinsic motivation to play the game	Challenge, discovery, entertainment

One of the major benefits you have identified with the GSDF is that it outlines a flow of design by identifying which dynamics support specific aesthetics and which mechanics support specific dynamics. So, decisions about design have a waterfall effect. At this point, you must reference the Barber et al. (2021) article to utilize the framework. You must first select aesthetics from "Table 1. Game-based Elements Identified as Aesthetics" (Barber et al., 2021, p. 293) and chosen as they align with the business problem/need and usage objectives. Then, using "Table 2. Game-based Elements Identified as Dynamics" (Barber et al., 2021, pp. 294–295), the chosen aesthetics are located in the 'supported aesthetics' column, and dynamics that support those are chosen. Lastly, "Table 3. Game-based Elements Identified as Mechanics" (Barber et al., 2021, pp. 297–298) is used to match the chosen dynamics with appropriate mechanics to make the final design decisions.

Once the decisions have been made, you can then incorporate them into the Game-based System Design Diagrams. During the design of a traditional information system, UML diagrams are used to sort out details around use cases, data content and flow, and sequencing. Those diagrams do not consider the game-based aspects of a gamified information system (Barber et al., 2021). The GSDDs will add those pieces to the documentation for use by the developers.

In summary, the steps of using the GSDF to create the GSDD are:

1. Create the business problem/need statement
2. Identify the usage objective(s)
3. Select aesthetics aligned with the user motivation and business need/problem
4. Select dynamics aligned with the chosen aesthetics
5. Select mechanics aligned with the chosen dynamics

It is important to note:

- A system design can have multiple GSDDs (because of multiple usage objectives)
- A GSDD should include one business need/problem and one usage objective
- A GSDD can include multiple aesthetics, dynamics, and mechanics

Additionally, it is important to note that the GSDDs can be created in software such as Visio, EdrawMax, draw.io, etc. These types of software enable export to PDF file formats which will allow all team members to review them. Refer to the Technical Appendix for more information about the GSDF and GSDD.

3.3.2 Screen Mockups

The final requirement for this stage of the gamified summer reading program is to create mockups that show ideas of what the game screens could look like. While it may not be possible to consider all screens, the designs must include:

- Introduction image screen
- Log in screen
- Character creation screen
- Basic level screen
- Reading log screen

The additional screens that are mocked up should give a vision to the aesthetics, dynamics, and mechanics that were chosen during the creation of the GSDD as well as the theme/story the team has

chosen. The director should be able to understand your vision for the gamified summer reading program when looking at the portfolio of screen mockups. This is where the creativity of your team really comes into play. The game could be a magical library that has magical creatures. It could have dinosaurs or puppies. One recommendation is to aim for an inclusive design. For example, try not to choose a design that targets a socially constructed group such as “boy” design or “girl” design.

4 Conclusion

Once you have completed the documentation for the gamified summer reading program, you can consider how it fits into the larger documentation of the system as a whole. What data would need to be captured by the gamified system? Could you create a list of user stories? What about use case diagrams, the entity-relationship diagram, and the data-flow diagram? All of these design pieces would fit together to create a full picture of the system which developers could then actualize with code. As you wrap up the project, consider which pieces of the GSDF and GSDD are easier and/or more difficult than the other diagrams used to design information systems. Why did you find them harder or easier? What have you learned from this experience that you would share with other system designers?

5 Resources and Additional Readings

- Barber, C. S., Petter, S., & Barber, D. (2021). All Work and All Play? A Framework to Design Game-based Information Systems. *AIS Transactions on Human-Computer Interaction*, 13(3), 287–315.
- Hunicke, R., LeBlanc, M., & Zubek, R. (2004). MDA: A Formal Approach to Game Design and Game Research. In *Proceedings of the AAAI Workshop on Challenges in Game*, 1–4.
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- Valacich, J. & George, J. (2020). *Modern Systems Analysis & Design*. 9th Edition. Pearson. Boston, MA.

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Appendix A: Technical Appendix

A game-based information system is, at its core, a basic information system. By definition, an information system is a set of components that collect, store, process, and disseminate data. A game-based information system does this as well. Figure 2 provides examples of data at each stage of the whole process. The difference is that it has game elements included that motivate users to play the game.

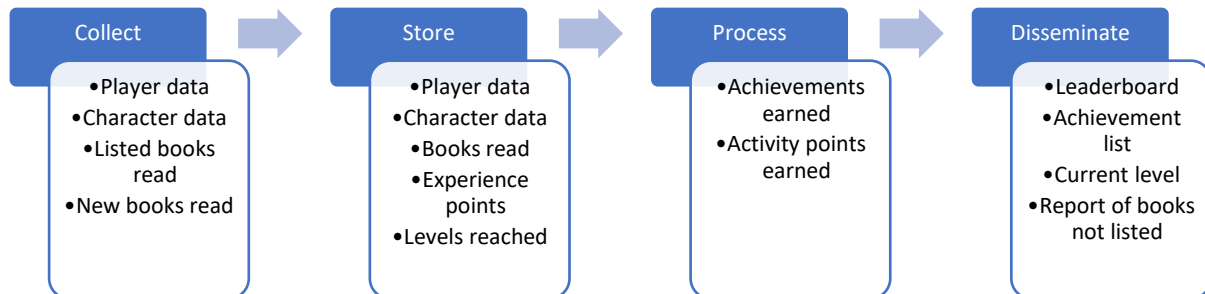


Figure 2. Examples of Data Processing in the Gamified Summer Reading Program

A standard SDLC or agile design methodology could be executed to design the game-based information system. The Game-based System Design Framework would be used during the Design stage of either methodology. Ideally, the GSDDs would be developed after the ERD and before the DFD. The ERD would aid designers in understanding what data needs to be generated and/or can be used in each screen of the game. The GSDDs would aid designers in understanding what the users are doing in the game to generate and/or use the data.

The importance of the GSDF rests in its alignment of the gaming elements with the business need/problem. Many gamification efforts fail because gaming sounds fun but the end result doesn't serve the business purpose. The steps of the GSDF during the design stage help to ensure that the outcome of the final game design will fulfill the requirements for the business and result in a successful gamification effort.

About the Authors

Connie S. Barber is an Assistant Professor of Business Analytics and Information Systems in the School of Business at the University of Arkansas at Little Rock, where she currently teaches courses in *Big Data Analytics Tools*, *Project Management*, and *Information Technology for Decision Making*. Her research addresses gamification in IS education, the use of massively-multiplayer online role-playing games to study virtual teams, the skills developed during online video game play that are transferrable to the workplace, and the unintended consequences of information systems. Her work is published in such journals as the *European Journal of Information Systems*, *Management Information Systems Quarterly Executive*, *Information & Management*, *Communications of the Association for Information Systems*, and the *Journal of Information Systems Education*.

Wenjun Wang is an Assistant Professor of Business Analytics and Information Systems in the School of Business at the University of Arkansas at Little Rock, where he teaches *Data Analysis and Visualization*, *Advanced Programming*, *Cloud-based Business Intelligence*, and *Information Systems Development Project*. He received his Ph.D. in Management Information Systems from the University of Iowa. His research interests lie in business analytics, social network analysis, information systems, and data science. His work is published in peer-reviewed journals including *Social Network Analysis and Mining*, *Applied Network Science*, *American Academy of Audiology*, *Innovation Economics & Management*, *BMC Bioinformatics*, *International Technology and Information Management*, *Information Processing and Management*, and *Microorganisms*.

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