Towards a Hybrid Educational-Persuasive Framework for a Library-Oriented Serious Game to Alleviate Library Anxiety

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Abstract. This paper proposes a Hybrid Educational-Persuasive Framework for designing serious games that alleviate library anxiety. Integrating pedagogical and persuasive elements, it emphasizes learner context, motivation, and gameplay mechanics to boost user familiarity and comfort, serving as a model for educational and persuasive game design across multiple domains.

Keywords: Serious Games, Libraries, Persuasive Design, Game-Based Learning.

1   Introduction

Serious games (SGs) are considered those video games that do not have entertainment as their primary purpose. Nonetheless, the aspect of entertainment should not be underestimated, as it is employed to support and reinforce the serious objectives of SGs (Ahrens, 2015). Despite some existing skepticism towards the potential of SGs to achieve their serious goals, numerous studies have demonstrated that they can be useful in a variety of fields, such as education, healthcare, business promotion, *etc.* (Djaouti et al., 2011). Within the GLAM sector—Galleries, Libraries, Archives, and Museums—these games offer innovative ways to present and interpret cultural heritage (CH), making it more accessible and engaging to diverse audiences. By leveraging interactivity, narrative, and gameplay mechanics, SGs can bridge the gap between CH content and contemporary users accustomed to digital media. While games focused on CH can be included in the broader area of educational SGs, because they offer some educational value, they are distinct from other educational games in that they prioritize the preservation and popularization of tangible and intangible CH (Laamarti et al., 2014).

In order to develop SGs, a number of design frameworks and methodologies have been proposed. They are important in the development of SGs because they establish a purposeful and structured connection between the purely gaming component with the

intended serious objectives, necessitating intentional, structured design. The creation of an SG requires cooperation between specialists possessing different backgrounds and expertise, who must be able to communicate efficiently for their skills to become complementary. An SG design team involves technical specialists, who lack a pedagogical perspective, cooperating with experts in the game's serious subject matter, who require assistance in producing a game that is engaging for their target audience (Djafarova et al., 2023). In order to achieve the desired results, both sides must meet on a common foundation—namely, the design framework.

This paper will focus on the development of a library-oriented SG and will assess a number of design frameworks that have been proposed in the relevant literature. Although the framework examples provide useful ideas and perspectives, SG design is essentially dynamic. It is often necessary to customize the insights derived from existing design frameworks and methodologies to address the specific needs of SG design within a particular domain or context (Braad et al., 2016). This paper will examine the specificity of library-oriented SGs, which are often instructional and persuasive, helping users to develop an understanding of how to effectively use the library and to feel comfortable using its space and tools.

2   The Place of Libraries in the GLAM Landscape and Corresponding Specifics of Library-Oriented SGs

Although GLAM institutions are frequently grouped together and their functions often overlap, significant distinctions exist. Historically, libraries have been responsible for the administration of predominantly paper-based textual collections. Museum collections, on the other hand, encompass a wide variety of artifacts, and the museum's primary function is to curate exhibitions of collected CH objects. In contrast, libraries and archives do not emphasize the exhibition of their CH holdings and hardly organize public presentations of their assets (Hvenegaard Rasmussen et al., 2022).

Furthermore, since the early 21st century, public libraries have had to rethink their purpose, core functions, and their role in society. Public libraries are increasingly expected to serve not only as book repositories and information hubs but also to behave as organizations with a social function within their respective communities (Barclay, 2017). Public libraries, in addition to being distraction-free spaces, increasingly hold social events, including literature readings, seminars, and exhibitions. Public libraries stress their role in providing information, educational resources, technology, and other benefits, but it is their physical space that has given them a unique advantage (Khan et al., 2021).

With the challenge of these transformations, libraries are facing existing adverse circumstances, which act as a hindrance to the implementation of the required innovations. Since the 1970s, researchers in the field of library studies have noticed a certain negative predispositions of potential visitors towards libraries. Constance A. Mellon coined the term "library anxiety" to describe this phenomenon, involving visitors experiencing intimidation, overwhelm, and embarrassment when they interact with libraries and librarians (Mellon, 1986). According to S. Bostick, the five factors contribute to library

anxiety are: 1) lack of knowledge about the library's organization and space; 2) staff-related issues; 3) mechanical barriers—difficulties using technology to access library collections; 4) personal barriers—low self-confidence in visitors in their skills necessary for library use; 5) lack of comfort and acceptance (Bostick, 1992; Carlile, 2007).

The research on reducing library anxiety emphasizes the need for guidance and labeling in the interior spaces and soft skills training for library personnel. Gamification and virtual environments are also considered as viable solutions, and the employment of SGs has the potential to reduce library anxiety (Danforth, 2011; Walsh, 2014).

Several implementations of SGs have occurred in the domain of library gamification. The majority of these solutions focus on the quality of interaction between visitors and the institution, and seek to mitigate library anxiety. Examples of such SGs are LibGO—an interactive storytelling game to familiarize visitors with the library's location and holdings (Nourse Reed & Miller, 2020); FYE—an "engaging library orientation module" developed by researchers at the University of California, San Diego for first-year students (Goldman et al., 2016), LibraryTree, OpenTree, BookedIn, and Lemontree—four analogous SGs introduced by the libraries of the University of Glasgow, Open University and the Universities of Manchester and Huddersfield respectively (Barr et al., 2016; Running in the Halls, 2025; The Open University, 2025). The augmented reality SG Art&Fact (Kratchanov & Minev, 2024) combines the holdings of different cultural institutions in the town of Plovdiv, attempting to unite the city of Plovdiv's CH artifacts into a digital cultural ecosystem.

In terms of establishing the desired learning outcomes of a library-oriented SG to reduce library anxiety, it is useful to consider the categorization of learning outcomes proposed by Kraiger et al. (1993). It makes a distinction between cognitive, skill-based, and affective outcomes (Fig.1).
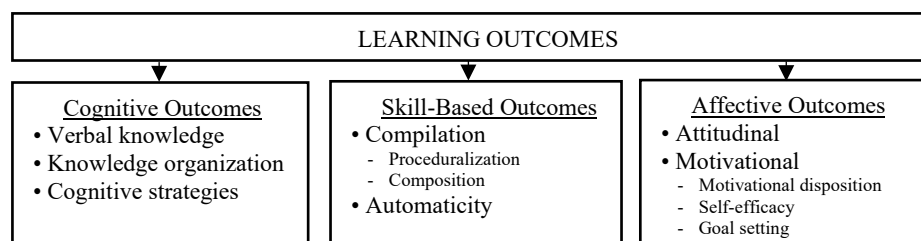

Fig. 1. Classification scheme for instructional learning outcomes (Kraiger et al., 1993).

The library-oriented SG would be focused on achieving affective outcomes, because its main purpose is to realize a change of attitude in the player and to persuade him/her to question any existing adverse predispositions towards the institution. It is also important to encourage a sense of self-efficacy in the player, which can serve as a motivation to apply the acquired knowledge in practice. The cognitive outcomes are also important, but to such a degree that they provide support for the realization of the affective outcomes. That is to say, the SG's intent should be to provide enough knowledge to encourage a change of attitude and motivation, rather than to overwhelm the player with thorough information on the complexities of the institutional apparatus.

3 Design Frameworks for SGs

Scholarly literature agrees that there is no single, universal SG design framework capable of covering all requirements for SG design because it is a complex, multifaceted, interdisciplinary process (Akpınar et al., 2023; McClintock, 2022). A review of existing SG design frameworks proposed by the research community indicates the absence of a singular, comprehensive model suitable for guiding the development of a library-oriented SG aimed at alleviating library anxiety. While several theoretical frameworks have the potential of wide applicability, they often remain highly abstract and lack the specificity required to inform concrete design decisions. Conversely, more detailed frameworks tend to be more granular and to emphasize either their educational or persuasive elements. The approach adopted in this article involves a critical examination of selected frameworks, with the aim of achieving an integration of their theoretical perspectives into a hybrid educational-persuasive framework. Following is a brief description of each of the three frameworks of interest.

The Four-Dimensional Framework (de Freitas & Jarvis, 2006), provides a structured approach to the design and evaluation of SGs, with focus on the educational contexts. It emphasizes the importance of considering not only the content of the game but also the broader learning environment and the individual characteristics of the player. The framework includes four dimensions—context, learner specification, representation, and pedagogy—with the aim to aid designers to align game elements with the intended educational objectives and to ensure effective learning experiences.

The **context dimension** focuses on where and how the game will be used. This includes the physical or digital environment (*e.g.*, classroom, online), the social setting (individual or group play), and the integration of the game into a broader curriculum or learning program. The **learner specification dimension** is the most important and "is a critical factor for how successful the game will be" (de Freitas & Jarvis, 2006). It considers the learner's background, learning styles, motivation, *etc*. This ensures the game design accommodates diverse learners, their needs and capabilities.

The **representation dimension** addresses how information is visually and interactively presented within the game, including the realism of the environment, the narrative structure, and the user interface. Finally, **the pedagogy dimension** focuses on the underlying pedagogical theory, such as the associative, cognitive, and situative perspectives. This ensures that game mechanics are purposefully selected to support specific learning outcomes.

While the Four-Dimensional Framework is valuable for aligning SG design with educational goals, it offers a high-level overview but can lack the specificity needed to guide concrete design decisions during development. For instance, the framework does not provide direct tools or methods for integrating game elements, like genre, rules, storytelling, *etc*. (Carvalho et al., 2015). The framework is in this way a starting point for conceptual analysis, but it needs to be supplemented by more granular models.

The Learning Mechanics–Game Mechanics (LM–GM) Model (Arnab et al., 2015) emphasizes a systematic alignment between learning mechanics—the methods and strategies to facilitate learning— and game mechanics—the interactive rules and

features that define gameplay. By giving designers two non-exhaustive sets of concepts, they can thereafter map relationships between the elements of the two sets. The LM-GM model thus tries to establish SG mechanics that achieve a balance between fun and engaging gameplay, that is at the same time purposefully structured to support cognitive, pedagogical outcomes.

The model is visualized as a matrix that links various learning mechanics, such as "repetition" and "simulation", with corresponding game mechanics like "levels" and "realism". This allows designers to select game features that reinforce desired learning behaviors.

The LM–GM model's focus is entirely on education and on cognitive outcomes. An SG targeting library anxiety must also provide the necessary tools to achieve affective outcomes, possibly by including a third set of affective mechanics to be aligned with the game mechanics. The LM–GM also does not include a player model (Arnab et al., 2015), which hinders the personalization of the SG design following the model. Nevertheless, the LM–GM Model is a valuable system that offers "concise means to map how ludic elements link to pedagogic intent directly based on a player's actions and game play, *i.e.*, SG mechanics" (Proulx et al., 2016).

The Persuasive Systems Design (PSD) Model by Oinas-Kukkonen and Harjumaa (2009) was created to guide the design of technologies aimed at changing users' attitudes or behaviors and provides a systematic approach for developing persuasive applications, including SGs. It separates the design process into three main phases (Oinas-Kukkonen & Harjumaa, 2009):

- Phase 1: Understanding key issues behind persuasive systems. In this first phase, the PSD model establishes a theoretical foundation by addressing fundamental principles related to persuasion.
- Phase 2: Analyzing the Persuasion Context. This core phase is concerned with identifying: 1) Intent–the designer's intent, the type and nature of the intended change; 2) Event–the user context (the characteristics of the tar-get users, such as their needs, interests, abilities, *etc*.) as well as the technology context (the platform or device capabilities), and the use context (the setting and other domain-dependent features); 3) Strategy–the high-level persuasion strategy and tactics the system will use. This involves deciding how the message will be conveyed (*e.g.*, direct or indirect persuasion).
- Phase 3: Design of System Features. In the final phase, the decisions made in the previous phases are translated into the design features and functionalities of the persuasive system (SG). The PSD model provides a total of 28 design principles concerning the content and functionality, grouped into four categories: primary task support, dialogue support, system credibility support and social support.

The designers decide which specific system feature principles (Phase 3) are applicable to the given persuasion context (Phase 2) and ensure they are aligned with the key issues (Phase 1).

While the Persuasive Systems Design (PSD) model is recognized for its "extensive conceptualization of technology-mediated persuasion" (Torning & Oinas-Kukkonen, 2009), it has certain limitations. Oyibo (2021) points out that PSD offers no mapping

between the concepts in the theoretical domain and the persuasive strategies in the technology domain, and lacks means for validation (Oyibo, 2021). Another critique is that PSD does not provide explicit methods to allow the system design to adapt to changes in the cognitive state of the users as they progress toward the target behavior (Wiafe et al., 2014).

4 Formulating a Design Framework for a Library-Oriented SG to Alleviate Library Anxiety

The hybrid educational-persuasive framework (HEPF) for a library-oriented SG proposed here takes as its basis the Four-Dimensional Framework (de Freitas & Jarvis, 2006), which is high-level and abstract, offering conceptual guidance on the overall design process. The Four-Dimensional Framework is designed mainly with pedagogical purposes in mind, but it can be augmented by additional elements to allow a shift in perspective (Collins et al., 2024). Its four interrelated dimensions—context, learner, representation, and pedagogy—influence and reinforce each other. Drawing from the Four-Dimensional Framework authors' prior experience with SG development projects, they recognize that successful outcomes depend heavily on clearly emphasizing learner-centered considerations, such as individual preferences, characteristics, and cognitive styles, as well as accurately identifying their specific learning requirements, including context of use, ICT proficiency, and desired learning outcomes (de Freitas & Jarvis, 2006). In the case of the proposed HEPF, in order to align the educational and persuasive agenda, the four dimensions have been supplemented by the corresponding elements of the PSD framework, while the LM-GM model was applied to the Representation dimension in order to provide concreteness in the matching of the ludic with the pedagogic elements (Fig.2).
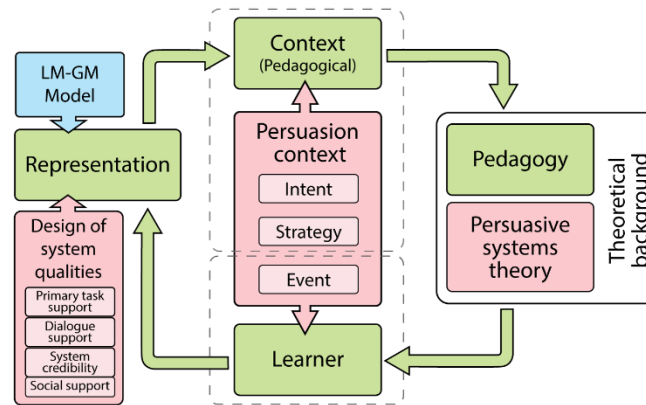

Fig. 2. Hybrid educational-persuasive framework.

This approach also provides the LM-GM with a player model (the Learner dimension), which was found to be lacking in its initial examination.

Adopting this combined framework approach offers several practical advantages for guiding design decisions. First, it provides a structured workflow: designers can start with the Four-Dimensional Framework to define the educational scope and requirements, then use LM-GM to generate ideas for game mechanics that meet those requirements, and finally apply PSD guidelines to refine those ideas for maximum motivational effect.

To practically apply the developed HEPF to the creation of a library-oriented SG aimed at alleviating library anxiety, designers should first define educational goals using the Four-Dimensional Framework. They must outline the library context, detailing spaces like reading rooms, borrowing areas, *etc*., and profile the potential users, focusing on their characteristics, cognitive styles, ICT proficiency, and specific anxieties (based on Bostick (1992)'s analysis). Pedagogical theories such as cognitive, situative, and associative strategies should be chosen to gradually familiarize the users with library environments without overwhelming them with information. Subsequently, employing the LM-GM model within the Representation dimension will concretely align educational objectives with appropriate game mechanics, such as guided exploration, NPC-driven missions, and storytelling. To further enhance player motivation and positively shape their attitudes toward libraries, PSD framework elements should be integrated. Finally, iterative testing and evaluation throughout development are essential, allowing designers to refine interactions between educational objectives, persuasive strategies, and gameplay mechanics, thus ensuring a cohesive and engaging experience.

5   Conclusions

The proposed HEPF offers a framework, which addresses the need to formulate a design methodology aimed at achieving combined pedagogical and persuasive outcomes, having as purpose the production of library SGs for alleviating library anxiety. Moreover, the framework provides a set of shared tools and terminology, which would align the efforts of the game designers and theory experts. This in turn has the potential to lead to the development of better-designed SGs with more effective outcomes (de Freitas & Jarvis, 2006).

The HEPF may be used not only in the field of library gamification but could be applicable to other endeavors that seek to combine both cognitive and affective outcomes. These could be applications in the field of health and medicine, environmental awareness, or business applications.

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